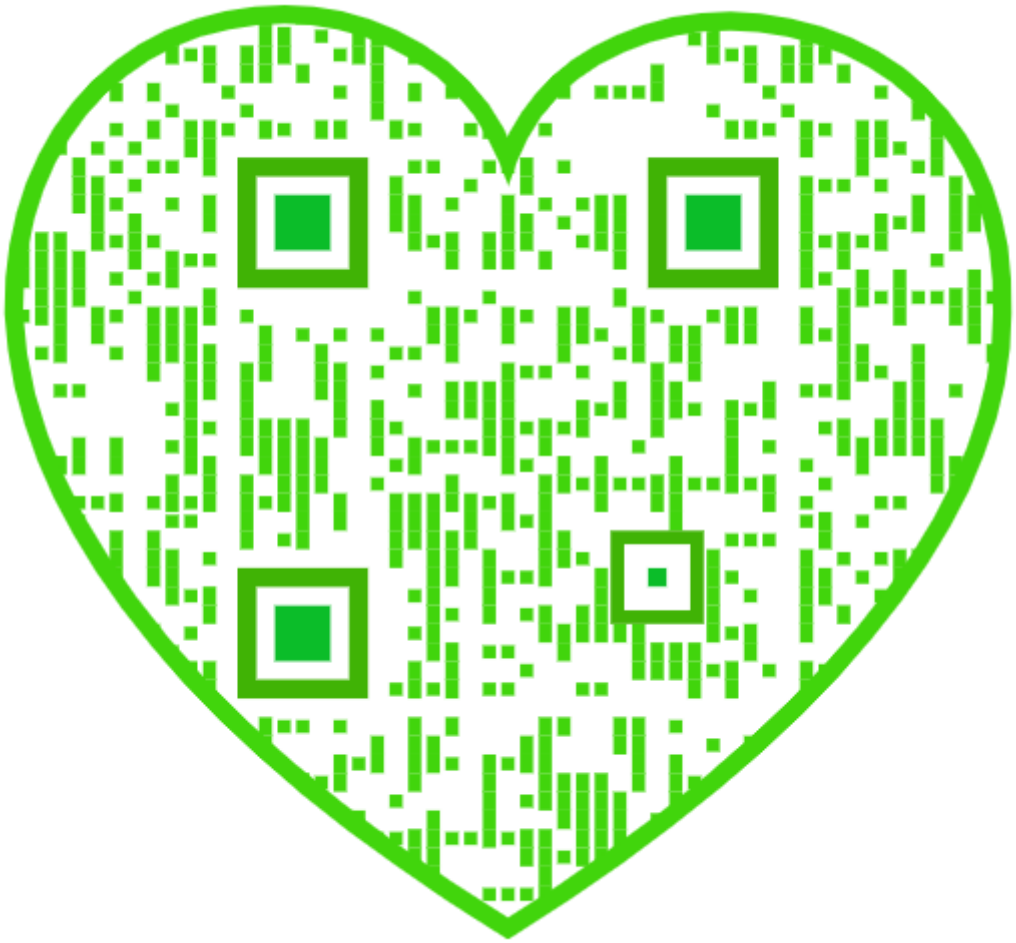

VIRTUS SOLA NOBILITAS.

CLARENCE JOHN BLAKE.

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THE

DISEASES OF THE EAR:

THEIR NATURE, DIAGNOSIS, AND TREATMENT.

THE

DISEASES OF THE EAR:

THEIR

NATURE, DIAGNOSIS, AND TREATMENT.

BY

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WITH A SUPPLEMENT BY

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EDITOR'S PREFACE.

I have been requested to add to the valuable work of Mr. Toynbee on Diseases of the Ear a brief statement of the advances which have been made, since it was published, in the branch of medicine of which it treats. The task is a most welcome one, knowing as I did the zeal and sagacity with which Mr. Toynbee's researches were carried out, and honouring, as I cannot but honour, his memory. I can only hope that the additions are not utterly unworthy of the volume; of the remarkable worth of which a fresh perusal has convinced me the more. It is indeed, as must have been the case, in a few points inexact, and in some others incomplete when judged by the present state of our knowledge. I have sought to the best of my ability to add whatever is necessary to make it a faithful, though a very brief, representative of all that is certainly known on the practical aspects of the subject. In no other volume that I am acquainted with is there contained an equally profound and exhaustive account of the physiological and pathological data on which the treatment of aural diseases rests, and much of that which I have added consists, as the reader will see, of new facts and new applications

of old ones for which we are indebted to the author's last researches.

I have added an Index, which I think will be found useful by all who have occasion to consult the volume. In it I have included the Supplement now added, to which I have also given, for convenience of reference, a separate Table of Contents.

JAMES HINTON.

London. September 10th, 1867.

THIS VOLUME IS DEDICATED

TO THE

Governors of St. Mary's Hospital, London,

WHO, BY ESTABLISHING AURAL SURGERY AS A DISTINCT DEPARTMENT
OF STUDY IN THEIR HOSPITAL AND MEDICAL SCHOOL,
EVINCED A DESIRE TO
ELEVATE THE SUBJECT OF DISEASES OF THE EAR TO ITS DUE POSITION,
AS A BRANCH OF PROFESSIONAL KNOWLEDGE,
BASED UPON CLINICAL OBSERVATION AND SCIENTIFIC RESEARCH.

PREFACE.

In preparing the present work, it has been my aim to produce a practical treatise on the Diseases of the Ear, having for its foundation the anatomy, physiology, and pathology of the organ. This volume, however, does not profess to give a complete description of the structure and functions of the Ear: it will be perceived that the domains of anatomy and physiology have only been entered upon, when requisite for the elucidation of the pathology or treatment.

And now, after twenty years' labour, seeing this volume complete, I cannot but regret that it is not more worthy of its subject, and of the intelligence of the Medical Profession, to which it is addressed. It only remains for me to continue to devote myself to my labours. And thus, while I sincerely thank the numerous members of the Profession for their generous assistance, in supplying me with the larger part of the means of research which I have enjoyed, I beg still further to solicit their aid. Long engaged upon another work, in the shape of "Illustrations of the Pathology of the Ear," for which

I possess a large amount of material, I nevertheless require much more. Indeed, even since this volume has been passing through the press, two recent specimens, received from medical men in the country, have elucidated two entire series of preparations in my Museum.*

I need scarcely draw attention to the beautiful illustrations in this volume, which, with two or three exceptions, were drawn from nature, on wood, by Mr. Ford.

Few references having been made in the body of this volume, to the investigations on which it is founded, I have given, in an Appendix, a list of my published papers, together with their dates, so that the reader may refer to them when he thinks it desirable to do so.

* It always affords me much pleasure to show my Museum to medical men.

18, Savile Row,
January 20, 1860.

CONTENTS.

CHAPTER I.

INTRODUCTION.

PAGE

Neglect of the study of the morbid anatomy of the ear, the cause of our ignorance of aural surgery—Mode of investigating the diseases of the ear—Method of dissecting the ear 1

CHAPTER II.

THE EXTERNAL EAR.

Anatomical observations—Use of the external ear—Effect of the removal of the external ear (case)—Pathological observations—Malformations of the external ear, with absence of the external meatus (cases)—Supernumerary ears—Inflammatory diseases—Chronic erysipelas—Chronic eczema—Cysts—Tumours—Deposits—Malignant disease .. 10

CHAPTER III.

THE EXTERNAL MEATUS.

ITS EXPLORATION.

Anatomical observations — Osseous meatus — Membranous meatus — Objects in exploring the meatus—Means of exploration—Lamps—Speculum—Mode of exploration 26

CHAPTER IV.

THE EXTERNAL MEATUS (*continued*).

ON FOREIGN BODIES AND ACCUMULATIONS OF CERUMEN IN THE MEATUS.

Foreign bodies in the meatus—Mode of removal—Cases—Ceruminous glands—Their diseases—Accumulations of cerumen—Their causes—Table of two hundred cases in which cerumen was removed—Symptoms—Effects—Treatment—Mode of removal—The syringe and its use—Cases 37

CHAPTER V.

THE EXTERNAL MEATUS (*continued*).

THE DERMIS AND ITS DISEASES.

PAGE

1. Acute inflammation :—*a*, Acute inflammation confined to the dermis—Treatment—Cases. *b*, Acute inflammation extending to the brain and its membranes—Treatment—Cases.
2. Chronic inflammation :—*a*, Chronic inflammation, with hypertrophy and accumulation of epidermis—Treatment — Cases. *b*, Chronic catarrhal inflammation — Treatment — Cases. *c*, Chronic catarrhal inflammation, extending to the bone and to the brain—Treatment —Cases. *d*, Ulceration 57

CHAPTER VI.

THE EXTERNAL MEATUS (*continued*).

POLYPI.

Causes of polypus—Symptoms—Three species of polypus :—1. The cellular raspberry polypus—Structure—Treatment with potassa cum calce—Cases—Treatment by removal with the lever-ring forceps—Cases. 2. The fibro-gelatinous polypus—Structure—Treatment—Cases. 3. The globular cellular polypus—Structure—Treatment—Cases 81

CHAPTER VII.

THE EXTERNAL MEATUS (*concluded*).

TUMOURS.

Osseous tumours—Structure—Two classes—Treatment—Cases—Mollusceous tumours—Structure—Effects on the bone—Treatment—Case—Conclusion of the subject of the diseases of the external meatus—Tabular view of the morbid conditions found in the meatus externus in 1013 dissections 107

CHAPTER VIII.

THE MEMBRANA TYMPANI.

STRUCTURE AND FUNCTIONS.

The epidermoid layer—The dermoid layer—The fibrous layers :—The radiate fibrous layer—The circular fibrous layer—The mucous layer —Tensor ligament —Functions of the membrana tympani 123

CHAPTER IX.

THE MEMBRANA TYMPANI (*continued*).

PAGE

The epidermoid layer—Dermoid layer—*a*, Acute inflammation—Treatment—Cases. *b*, Chronic inflammation—Cases. *c*, Ulceration—Cases. Fibrous laminæ: *a*, Acute inflammation. *b*, Chronic inflammation. *c*, Ulceration. *d*, Calcareous degeneration. *e*, Relaxation of the membrana tympani—Treatment—Cases.. 137

CHAPTER X.

THE MEMBRANA TYMPANI (*concluded*).

Perforation, causes—Physiological observations—Experiments previous to the formation of an artificial membrana tympani—On the artificial membrana tympani—The mode of applying it—Cases—Rupture of the membrana tympani—Physiological observations—Pathological observations—Cases 159

CHAPTER XI.

THE EUSTACHIAN TUBE.

Anatomical observations—Physiological observations—Pathological observations—Seat of obstruction in the Eustachian tube:—1, The faucial orifice. 2, The tympanic orifice. 3, Middle part.—Causes of obstruction:—1, Thickened mucous membrance. 2, Relaxed mucous membrane. *a*, Obstruction of the faucial orifice from thickened mucous membrane—The exploration of the tube—The otoscope—Treatment—Use of the Eustachian catheter and of the explorer—The excision of the tonsils—Cases. *b*, Obstruction of the Eustachian tube at its faucial orifice from relaxed mucous membrane—Symptoms—Treatment—Cases. *c*, Obstruction of the Eustachian tube at the tympanic orifice from thickened mucous membrane—Symptoms—Treatment—On the operation of puncturing the membrana tympani. *d*, Obstruction of the middle part of the Eustachian tube by mucus, by stricture, or by membranous bands 188

CHAPTER XII.

THE CAVITY OF THE TYMPANUM.

Anatomical observations—Pathological observations—Diseases of the mucous membrane:—*a*, Congestion. *b*, Acute inflammation—Affecting the portia dura nerve—Extending to the brain—Scrofulous matter in the tympanic cavity. *c*, Chronic inflammation. *d*, Chronic catarrhal inflammation. *e*, Chronic catarrhal inflammation extending to the bone, dura mater, or brain. *f*, Ulceration of the mucous membrane 225

CHAPTER XIII.

THE CAVITY OF THE TYMPANUM (*concluded*).

PAGE

a, Rigidity of the mucous membrane—Cause of deafness in advancing years—Treatment—Cases. *b*, The formation of bands of adhesion. *c*, Anchylosis of the stapes to the fenestra ovalis—Pathological observations—Treatment—Cases. *d*, Disconnexion of the incus and stapes—Physiological observations—Pathological observations—Cases 266

CHAPTER XIV.

THE MASTOID CELLS.

Anatomical observations—*a*, Diseases of the mastoid cells in childhood—Cases of the disease advancing to the bone and the cerebrum. *b*, Diseases of the mastoid cells in the adult—Acute inflammation of the mucous membrane—Chronic inflammation of the mucous membrane—Purulent infection—Symptoms of remittent fever—Caries of the lateral sulcus—Abscess in the cerebellum. *c*, Necrosis of the mastoid process—Paralysis of the portio dura nerve—Treatment—Opinion respecting life insurance in cases of discharge from the ear .. 300

CHAPTER XV.

THE DISEASES OF THE NERVOUS APPARATUS OF THE EAR, PRODUCING WHAT IS USUALLY CALLED "NERVOUS DEAFNESS."

a. Diseases in which the ear alone is affected:—1. From concussion—Three modes—Blows on the ear—Loud sounds—Falls. 2. From the application of cold—Cold air—Cold water. 3. From the effect of morbid poisons—Rheumatic fever—Typhus fever—Scarlet fever—Mumps—Gout.

b. Diseases in which the brain, as well as the ear, is affected:—1. Mental excitement—Over-study—Sorrow. 2. Bodily Debility—Want of sleep—Accouchements—Over-exhaustion in hot climates—Fasting—Neuralgia 348

CHAPTER XVI.

THE DISEASES OF THE NERVOUS APPARATUS (*concluded*).

Ulceration of the membranous labyrinth—Caries and necrosis of the petrous bone 374

CHAPTER XVII.

MALIGNANT DISEASE OF THE EAR.

PAGE

Origin in the mucous membrane of the tympanum—Destruction of the petrous bone—Sometimes mistaken for polypus—Operations to be avoided—Brain and dura mater involved—Treatment 386

CHAPTER XVIII.

ON THE DEAF AND DUMB.

Diseases producing deaf-mutism—The condition of the ears in the deaf and dumb, as ascertained by examination during life—The condition of the ear in the deaf and dumb, as revealed by dissection—The mode of examining a child supposed to be deaf and dumb—On the medical treatment of the ears of the deaf and dumb—The amount of hearing possessed by children usually accounted deaf and dumb—On the education of the deaf and dumb, with cases 395

CHAPTER XIX.

EAR-TRUMPETS AND THEIR USE 417

APPENDIX.

List of published papers on the Structure, Functions, and Diseases of the Ear 419

THE DISEASES OF THE EAR.

CHAPTER I.

INTRODUCTION.

NEGLECT OF THE STUDY OF THE MORBID ANATOMY OF THE EAR, THE CAUSE OF OUR IGNORANCE OF AURAL SURGERY — MODE OF INVESTIGATING THE DISEASES OF THE EAR — METHOD OF DISSECTING THE EAR.

As introductory to this work on the Diseases of the Ear, I may be pardoned the observation, that the subject has hitherto been too much regarded, by the great mass of the Profession, as a blank in Medical Science; indeed, to quote from Mr. Wilde's introduction to his valuable treatise on Aural Surgery, medical men are too ready to affirm that "they know nothing about the diseases of the organ of hearing;" and many, looking upon the difficulties that surround the investigation as insurmountable, have tacitly abandoned its pursuit. Yet, if we carefully survey the history of the rise and progress of Aural, as a distinct branch of Scientific Surgery, one main cause of the disrepute into which it had fallen may be traced to the neglect of the Pathology of the organ of hearing—a neglect that doubtless led also to the ignorance which has prevailed as to the structure and functions of some of the most important of its parts.

It is a question, however, whether the inherent difficulties of Aural Surgery are of a nature to prevent its being as thoroughly understood as the other branches of Surgery. This question has been answered in the affirmative by some, on the ground of the deep and hidden situation of the larger part of the organ, and the extreme intricacy of its structure. But surely the organ of

hearing is not so much concealed from view as several others (the heart, for instance), of whose diseases we have a very clear knowledge; nor is its structure more complicated than that of the eye. The result of my own experience, and I think also of those who have carefully attended to my practice at St. Mary's Hospital, is, that the diseases of the ear are not more difficult to diagnose, nor are they on the whole less amenable to treatment, than those of the eye, the joints, or almost any other organ that can be named.

When my attention was first turned to the study of the diseases of the ear, I resolved to prosecute researches into the pathology of the organ. From that time to the present, I have made nearly 2000 dissections; and although it must be manifest that this number is small, compared to that which is required for the thorough elucidation of the subject, still I feel it is a sufficiently solid foundation upon which to build a rational system of Aural Surgery.

Fully aware of the difficulties in the way of procuring specimens from those deaf persons who had been inspected during life, and whose histories had been recorded, I determined at once to dissect every ear that I could obtain, in order to ascertain what are the most common morbid conditions to which the organ of hearing is subject; in fact, to secure one step first, by ascertaining something of the *morbid anatomy* of the ear, before advancing to a consideration of its *pathology*. The result of my investigations established this general fact, that the existence of some of the most important affections of the ear had not even been imagined. Having advanced thus far with the morbid anatomy of the ear, my next step was to pursue its pathology. This was effected, in the first place, by prosecuting inquiries into the history of the patients whose ears were found to be diseased; secondly, by dissecting the ears of deaf persons supplied to me by medical men, and comparing the morbid appearances observed with the notes accompanying the cases; and thirdly, by availing myself of the opportunity, during some years, of inspecting all the deaf persons in an institution containing more than 2000 individuals, of recording their cases, and then of making dissections of the organ of hearing in those who died. By these means, and by the facilities offered at the public institutions to which I have been attached, of conducting post-mortem

inspections of the patients attended by me, I have been able in many cases to compare the symptoms occurring during life, the appearances of the organ, and the history of the case, with the morbid structures found after death.

Mode of investigating the Diseases of the Ear.—The following plan for eliciting all the important particulars with which a Surgeon ought to be acquainted when endeavouring to form a diagnosis of disease of the ear, has been pursued by me during many years. Its use involves no great time or labour; and as it is desirable that it should be observed by those studying the subject, I will describe it in detail.

I. The age and occupation of patient.

II. State of health, temperament, condition of pulse, &c.

III. If any relations are deaf, name them.

IV. History of the affection; duration; supposed cause. *Former symptoms:* if at any time pain in the ears or head. *Nature of progress:* whether rapid or slow; if it has increased by sudden paroxysms, or by imperceptible degrees. *Present symptoms:* if pain, noises, or discharge; amount of hearing power as shown by conversation; whether the patient require to be spoken to distinctly in a room, or within the distance of a yard, or close to the ear: which ear is the worse. *Causes aggravating the deafness:* a cold, cold or moist weather, bodily fatigue or mental excitement, the act of mastication. *Causes producing improvement:* improved health, dry air, a cold, cold weather, warm weather.

V. Result of examination.

Right ear. The distance at which the watch is heard.*

Meatus: quantity and condition of the cerumen; state of the dermis and of the osseous wall.

Membrana tympani: surface dull or shining, transparent or opaque, state of the triangular bright spot; if more or less concave than natural.

Eustachian tube: if air is heard by means of the otoscope to enter the tympanic cavity naturally during deglutition, the nose and mouth being closed; if the air is heard to enter the tympanic

* The medical man should ascertain the distance at which his watch is usually heard by persons whose hearing power is supposed to be perfect. The hearing distance with my own watch is about three feet. The watch should be gradually brought towards the ear instead of being withdrawn from it.

cavity naturally during a forcible attempt at expiration with the nose and mouth held closed.

Left ear : ditto. State of mucous membrane of the fauces.

VI. Previous treatment.

VII. Diagnosis.

Although this enumeration of all the points which require filling up, might lead to the idea that the use of this plan must be attended with considerable trouble in actual practice, it will be found otherwise, as numerous abbreviations may be resorted to. For example, take the following case.

F. R., æt. 43, architect. H. (health) : tolerable, but subject to attacks of sore throat. R. D. (relations who are deaf) : A brother and sister were both deaf when young, but quite recovered before reaching the age of 20.

H. (history) : When a boy, suffered from ear-ache, which was often followed by deafness and sometimes by discharge from each ear. Subsequently the attacks of ear-ache ceased ; but he has ever since been subject to fits of deafness which have usually come on during an attack of cold, and have lasted for periods varying from two to several weeks. During the attacks, the power of hearing has been so much diminished, that he could only hear a loud voice when within the distance of half a yard. Each attack has usually disappeared with the occurrence of a sudden crack in the ear. The present attack came on six months ago, after a bad cold ; it has been slightly relieved on one or two occasions, but the deafness speedily returned. At the present time he requires to be spoken to in a loud voice within a yard of the ears, and there is a constant singing with a sensation of pressure in them, and a feeling as of weight on the head. P. T. (previous treatment) : The application of glycerine to the meatus ; syringing with warm water ; blisters behind the ears ; the use of the Eustachian catheter and a pump over the ears, all without benefit. R. E. (right ear) : M. E. (meatus externus) contained cerumen in a normal quantity and consistence. M. T. (membrana tympani) : Outer surface glassy ; the bright spot more elongated than natural, and somewhat striated ; the membrane of a leaden hue, and much more concave than natural. E. T. (Eustachian tube) : No air is heard to enter either during the act of swallowing or during a forcible expiration with closed mouth and nose, neither does the patient feel any sensation in

the ears, nor is the membrana tympani seen to move during these operations. H. D. (hearing distance): Contact. L. E. (left ear): the same as the right, except that the membrana tympani is somewhat opaque. The watch is only heard when pressed upon the ear.

The mucous membrane of the fauces is red and spongy, and much thicker than natural; and each tonsil is somewhat enlarged.

D. (diagnosis): Occlusion of the faucial orifice of each Eustachian tube by thickened mucous membrane. The grounds for forming this diagnosis are:—

Firstly. The history of the case, the constitution of the patient, the peculiar similar attacks which had occurred to a brother and sister, and especially the sudden attacks of deafness following a cold, and their sudden disappearance after a crack, the latter being caused by the sudden entrance of the air into the tympanic cavity, and the return of the membrana tympani to its natural position.

Secondly. The concave condition of the membrana tympani, which showed that there was very little air in the tympanic cavity, while there was no history of other disease to cause the concavity. The reason for assuming that the obstruction was at the faucial and not at the tympanic orifice, was the fact that the membrana tympani was translucent in one ear, and only slightly opaque in the other; whereas, an amount of inflammation sufficient to cause obstruction at the tympanic orifice of the tube, would necessarily be attended by considerable thickening of the mucous membrane lining the inner surface of the membrana tympani, and produce great opacity.

Thirdly. The condition of the mucous membrane of the fauces, and the result of the exploration of the tube by means of the otoscope.

T. (treatment): The object is to reduce the mucous membrane covering the orifices of the tubes to a natural condition, so that the muscles may be enabled to open them. For this purpose the solid nitrate of silver was applied to the mucous membrane of the fauces twice a week, and an astringent gargle was also used; small doses of quinine and colocynth were administered each night. The surface of the body was directed to be rubbed daily with a towel dipped in cold water, and abundant exercise on foot was recommended.

The result of this treatment was to produce some slight improvement in the course of the first week; in the course of the second, a crack took place in the right ear, which was followed by a perfect restoration of the hearing in that organ; the air was then heard to enter, upon slightly forcing it; but it did not yet find its way during the act of deglutition. In the course of a day or two the left ear also improved greatly, though not equally with the right. This may be accounted for by the thickened state of the mucous membrane of the tympanum on that side.

Now the case just cited is illustrative of a large proportion of the cases met with in the practice of Aural Surgery. I mean, that in most cases, by a careful attention to the history, aided by an efficient examination of the organ, a medical man can form a tolerably accurate diagnosis. It has often been asked, how is it possible to diagnose between anchylosis of the stapes and nervous deafness, two cases in which perhaps no disease of the organ is apparent? But the history of the origin and progress of the cases, the nature of the patients' constitution, and the symptoms of the diseases, are quite sufficient to remove any difficulty on the subject. Indeed, so much is capable of being learned from the history of a case, that very often a pretty accurate diagnosis may be formed without ocular inspection. For instance, in the above case my mind was made up as to its nature before making any examination. Again, the condition of the Eustachian tube is to be learnt by the state of the membrana tympani. When this tube is obstructed, the air that was contained in the tympanic cavity disappears, in part, in the course of a few hours, either from absorption or exosmosis. The effect of this partial disappearance of the air from the tympanic cavity is, that the membrana tympani becomes drawn inwards and very concave externally; and although this peculiar condition of the membrana tympani is met with in other diseases of the ear, their history differs from that of simple obstruction of the Eustachian tube.

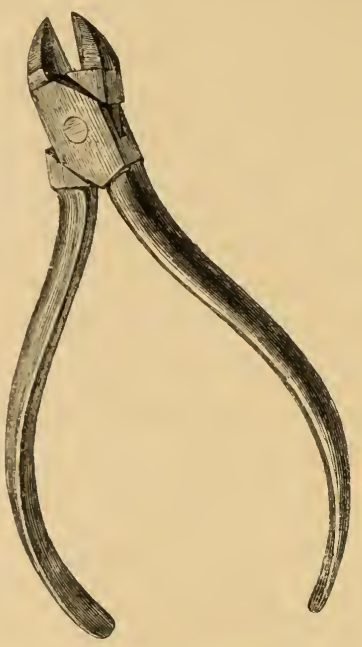
My object in citing the foregoing case has been to show that after carefully collecting the history of a case, and making a thorough inspection of the organ, there is generally not much difficulty in forming a tolerably correct diagnosis.

Method of dissecting the ear.—In concluding these introduc-

tory observations, I will give some directions respecting the mode of removing and dissecting the petrous bone.

The simplest method of removing the ears for the sake of dissection, is, in the first place, to saw off the calvaria in the usual way, and then to take out both the petrous bones together, by means of two transverse vertical sections, one in front of the two petrous bones and the other posterior to them. The anterior of these sections should pass in a line a little anterior to the anterior clinoid processes, and the posterior in a line through the posterior third of each mastoid process. By means of these two sections the trumpet-shaped extremity of each Eustachian tube, a portion of the mucous membrane of the fauces, and the whole of each petrous bone, together with the mastoid processes, can be taken out. The disadvantage of this procedure is the disfigurement which is apt to ensue from the falling in of the face. To avoid this disadvantage another mode of removing the ears may be resorted to ; this consists in taking out each petrous bone separately in the following manner :—The calvaria having been sawn off, an anterior section is to be made on each side on the same line as in the above plan, but extending only as far as the outer part of the body of the sphenoid bone ; a posterior section on each side is then to be made, as in the first plan, but not extending further inwards than the basilar process of the occipital bone. These two sections are to be made with a saw, or with a chisel and hammer ; the apex of each petrous bone is then to be separated from the sphenoid and occipital bones, and each petrous bone (the outer ear and integument being detached and reflected downwards) is to be drawn outwards, taking care, by inserting the scalpel deeply, to remove as much of the soft parts as possible. With this second plan there is a difficulty in removing the whole of the guttural portion of the Eustachian tube ; with care, however, this portion may be removed, especially if the final sections separating the petrous bone from the occipital and sphenoid be made to pass obliquely from above, downwards, and inwards. The organ of hearing having been removed, the dissection may be conducted in the following manner :—The auditory nerve in its meatus should be first carefully examined, premising that a previous inspection has been made of the portion of the brain to which the portio mollis and portio dura nerves are attached. The size of the external

meatus having been ascertained by allowing a strong light to fall into it, its anterior wall is to be removed by the cutting forceps, made by Messrs. Ash, of Broad-street, Golden-square;



CUTTING FORCEPS.

the state of the epidermis, the ceruminous glands, and secretion, the dermis, periosteum, and bone, are to be noticed. The outer surface of the membrana tympani is then to be examined; also the state of its epidermoid and dermoid laminæ, its degree of tension, and the amount of motion possessed by the malleus when pressed upon by a fine point. The next step is to ascertain the condition of the guttural portion of the Eustachian tube, to lay open the cartilaginous tube with the scissors, and then to expose the cavity of the osseous portion by means of the cutting forceps. In doing this, the tensor tympani muscle is exposed; its structure should be examined, and, if it has not a healthy appearance, portions of it should be submitted to microscopic inspection. The upper wall of the tympanum is next to be cut away, by means of the cutting forceps; in doing this, great care must be taken not to disturb or disconnect the malleus and incus, which lie immediately beneath it. After the tympanic cavity has been exposed, the first step is to pull the tensor tympani muscle, and to ascertain how far it causes a movement of the membrana tympani and ossicles. The incus and stapes are now to be touched with a fine point, so as to ascertain their degree of mobility; the tendon of the stapedius

muscle is also to be pressed upon. The condition of the mucous membrane of the tympanum, and of the mastoid cells, is then to be ascertained, and any peculiarity of the cavity, the existence of bands of adhesion, etc., to be noted. The most delicate part of the dissection, viz., that of the internal ear, must now be undertaken. The cavities of the vestibule and cochlea are to be exposed, by removing a small portion of the upper wall of each. Before reaching the vestibule, the superior semicircular canal will be cut through and removed; the membranous canal should be drawn out and inspected. As the cavities of the vestibule and cochlea are laid bare, it is desirable to see that the quantity of perilymph is natural, as well as its colour and consistence. The outer surface of the membranous labyrinth having been observed, it should be opened so as to expose the endolymph and otoconia, portions of all which parts should be removed for microscopic inspection. This having been effected, the remaining membranous semicircular canals are to be exposed, and the connexion of the base of the stapes to the fenestra ovalis carefully examined. The last stage of the dissection consists in removing parts of the lamina spiralis, in examining them microscopically, and in exposing from within, by following the course of the scala tympani, the membrane of the fenestra rotunda. The only organ which now remains unexamined, is the stapedius muscle: in order to expose it, the course of the aquæductus Fallopii, beginning at the stylo-mastoid foramen, should be followed until the base of the pyramidal eminence, containing the muscle, is reached.

CHAPTER II.

THE EXTERNAL EAR.

ANATOMICAL OBSERVATIONS—USE OF THE EXTERNAL EAR—EFFECT OF THE REMOVAL OF THE EXTERNAL EAR (CASE)—PATHOLOGICAL OBSERVATIONS—MALFORMATIONS OF THE EXTERNAL EAR, WITH ABSENCE OF THE EXTERNAL MEATUS (CASES)—SUPERNUMERARY EARS—INFLAMMATORY DISEASES—CHRONIC ERYSIPELAS—CHRONIC ECZEMA—CYSTS—TUMOURS—DEPOSITS—MALIGNANT DISEASE.

Anatomical Observations.—The external ear is not unfrequently described as a portion of the external auditory meatus. There are, however, peculiarities in the structure, functions, and diseases of these two divisions of the ear, that render it desirable for them to be considered separately. The external ear, comprising under that name all parts of the organ external to the meatus, is placed between the articulation of the lower jaw and the mastoid process, and consists of a basis of resilient cartilage, covered by common integuments, the two being connected by firm cellular tissue. On the outer surface of the ear the integuments are so firmly attached to the cartilage that it is difficult to draw them apart, or even to move the one upon the other. The skin of the ear is so abundantly supplied with blood-vessels that a dried specimen I possess, injected with size and vermilion, has, at first sight, the appearance of a mass of colouring matter, which, upon minute examination, is found to depend upon its vessels, that form a very dense network throughout every part. The lobule of the ear consists of a fold of integuments, which contains cellular tissue and a small quantity of adipose matter. The cartilage presents externally several depressions and elevations; it forms the concha, the large concavity looking obliquely outwards and forwards and bounded in front by the triangular projection called the tragus, which looks obliquely inwards and backwards, facing the concha. Posterior, and slightly inferior

to the tragus, is the antitragus. Extending upwards from the latter is the antihelix, which forms the rounded curved projection of the outer ear, and divides above and in front into two branches: of which the inferior and more prominent terminates under the helix by which it is concealed; while the superior branch is very rounded, and seems as if it were the continuation of the antihelix. Between the two branches is a fossa, called the fossa innominata, or the fossa of the antihelix. The helix is the curved ridge which forms the posterior and superior boundary to the ear: it commences in the cavity of the concha, which it divides into two parts, the inferior being the larger, and passes obliquely forwards and upwards above the tragus; then curving backwards and downwards, it is continuous inferiorly with the lobule. Above the tragus, the helix usually consists of a flat band of cartilage, the inner surface being applied against the superior branch of the antihelix, and the superior part of the concha. This arrangement of the helix screens a portion of the integuments beneath it from view and from contact with the air. This portion ought to be carefully cleansed and dried, especially in children. In some persons the helix is absent; and in certain cases of malformation there is no cartilage in the external ear.

Use of the External Ear.—Opposite opinions have been entertained respecting the influence of the external ear upon the hearing power. Itard denied that it was of any use, while others have considered that it is of very material service in collecting the sonorous vibrations and in conducting them to the meatus. Richerand says that the external ear may be removed without deafness being the consequence: "For a few days after the loss, the hearing is rather hard, but the infirmity gradually diminishes, the increased sensibility of the auditory nerve compensating for the imperfection of the organic apparatus." Dr. Hennen cites a case that he met with, in which the external ear was completely removed by a cannon-shot, and yet the sense of hearing was as acute as ever. Wepfer relates a case in which the outer ear was destroyed by ulceration, but the hearing power was not diminished. Itard says: "Everything combines to show that the auricle is absolutely useless in man; that the hearing is not altered when it is removed, I have had occasion to assure myself most positively." (*Traité des Maladies*

de l'Oreille, T. I. 1821.) He owns, however, that this opinion has been opposed by various anatomists, among whom may be cited Valsalva and Haller, who state positively, that although the loss of the outer ear does not produce deafness, it is always accompanied by a diminution of the hearing power. Leschevin also states that those who have lost the external ear, or have it naturally too flat or ill-shaped, have the hearing less acute. (*Cooper's Surgical Dict.* 7th Ed. p. 469.)

An examination of the details of the cases from which deductions have been drawn respecting the functions of the external ear, shows that experiments sufficiently careful to decide the question were not performed. In those instances in which a diminished power of hearing was detected, the condition of the other parts of the organ is not recorded; and where the patients are described as hearing perfectly, no accurate test of the hearing power was employed; nor does it appear that sufficient care was taken to ascertain whether the supposed perfect hearing depended upon the organ that remained unmutilated. I am, therefore, happy that it is in my power to record a case in which these particulars were carefully noted.

Case. The right external ear removed.—W. B., a sailor, aged 33. The whole of the upper portion of the left auricle is absent. The antitragus remains, and also a portion of the tragus, about equal to it in size; below these the remnant of the lobe slopes gradually down to the side of the neck. He states that his ear was bitten off by another sailor at one of the Navigator Islands; but the state of the parts rather indicates a removal by a cutting instrument. The patient had come from California, where the practice existed of cutting off the right ear of a thief. He was anxious to return to California, but very unwilling to appear there without his right ear, and therefore applied to me to aid him in obtaining an artificial substitute. His very long hair entirely concealed the remaining ear, and prevented any one from detecting the absence of the other. Long hair in men was, however, in California so suspicious a feature, that wearing the hair short about the ears was not merely fashionable, but absolutely essential to a respectable appearance. When examining the patient, I found that each meatus contained cerumen, after the removal of which by the syringe, he heard the watch equally well with either ear, at a distance of two feet: nor, after careful

experiments, could I detect any difference between the hearing power of the two ears. I sent this patient to the ingenious Mr. Rein, from whom, I doubt not, he obtained what he required.

Pathological Observations.—The two classes of disease of the external ear for which the assistance of the surgeon is sought, are—first, malformations, and, secondly, various kinds of inflammation; to these may be added cases of cysts and tumours, which are, however, comparatively rare.

I. *Malformations of the external ear* generally co-exist with partial or entire absence of the external meatus; but as the state of the outer ear usually attracts attention first, I shall consider the two conditions together in this place. Sometimes the tragus is pressed backwards and inwards so as to close the meatus; in such a case, the patient must wear habitually a small silver tube, or have a portion of the tragus excised. A much more serious malformation, and unfortunately one that is not uncommon, consists in the absence of the cartilage of the external ear, together with the external meatus; the only representative of these parts being one or more soft and shapeless duplications of the integuments: sometimes, indeed, there is no vestige of either meatus or auricle.

The attention of the surgeon is called to cases of malformation of the external ear, in order that he may give an opinion, in the case of infants newly born, as to the amount of hearing they are likely to possess; or when children with this affection grow up with a certain degree of hearing, to decide whether an operation will probably be of any benefit; and, lastly, to do all in his power to diminish the deformity arising from the partial absence of the external ear.

A case is cited by Mr. S. Cooper (loc. cit. p. 470) of a child he saw, when it was exhibited in London as a curiosity, which was wholly destitute of external ears, and in whom no meatus auditorii were visible. The child, nevertheless, "could hear a great deal, although the sense was certainly dull and imperfect." No careful investigation seems to have been made of this case, nor is it stated whether the presence of any meatus auditorii could be detected through the integuments. Judging from somewhat analogous cases which will be cited, it is most probable that the meatus was entirely absent.

Fritelli and Overteuffer are also quoted by Cooper, as having

seen cases in which the outer ear was entirely absent. The former says that the physiognomy of the child resembled that of an ape, and the latter states that his patient heard very well. In some instances the auricle is deformed without any abnormal condition of the meatus or tympanum; but, as a general rule, malformation of the external ear is accompanied by a defective development of the meatus and tympanic cavity.

This subject has been examined with care by Professor Allen Thomson, who published a notice of several cases of malformation of the external ear, and of experiments on the state of hearing in such persons, in the *Edinburgh Journal of Medical Science* for April, 1847, to which is appended an account of the dissection of a similar case of malformation by myself. It appears that there are upon record only three dissections similar to those now under consideration: of these, one is described by Professor Jaeger of Erlangen, one is in the museum of the University of Edinburgh, and the third is one made by myself, at the request of the Pathological Society of London, before whom it was brought by Dr. Lloyd. In the first two instances, one ear only was affected. "In both (quoting Dr. Thomson), the labyrinth appears to be quite naturally formed; the cavity of the tympanum and the bony Eustachian tube exist, but are much smaller than usual. The chain of ossicles differs materially from the natural structure, being united, in one of the examples, into one straight and simple piece, and, consequently, assuming very much the form and appearance of the columella of birds or reptiles. The most striking departure from the normal form of the bone consists in the entire obliteration of the meatus externus, which seems to be connected with the absence of that portion of the temporal bone which forms the tympanic ring and lower side of the bony canal of the meatus, and the extension backwards of the articular or true glenoid portion of the temporal bone to twice its natural breadth. There is a total deficiency, therefore, of what may be termed the tympanic bone, or of that which forms the posterior non-articular part of the glenoid cavity of the temporal bone, intervening between the fissure of Glasser and the vaginal ridge of the spinous process. Were this part of the bone merely deficient, the cavity of the tympanum would be left freely open below; but in the two bones now described, it seems to be closed by the unusual exten-

sion of the glenoid or articular portion of the bone backwards." In reviewing the cases recorded by him, and comparing them with the results of dissection, Dr. Thomson arrives at the conclusion that the following are the most prominent points of deviation from the natural form and structure:—"1st. An incomplete development of the integumental part of the apparatus, viz., the external auricle and outer part of the meatus. 2nd. The absence of the membrana tympani ring and bony part of the meatus, in consequence of the incomplete development of the tympanic bone, or a part of the structure which, in the lower animals, bears that name. 3rd. The defective state of the cavity of the tympanum and chain of small bones. 4th. Occasional irregularity or deficiency in the development of the malar, palatal, and maxillary portions of the face." My own dissection was laid before the Pathological Society in 1847: both ears were equally affected. The external ear consists of a fold of integument of much the same shape and size as the natural lobe, but directed forwards, so that the concave surface which usually looks outwards is directly applied to the surface of the head, and conceals the tragus, which is rather smaller

MALFORMED RIGHT EXTERNAL EAR OF A CHILD.

than natural. There are two orifices on the upper part of the interior surface of the appendage, and one at its posterior part: these are the openings of mucous follicles. The meatus externus is entirely absent, and a slight depression in the integuments is the only indication of its usual position. Upon removal of the integuments, no meatus or membrana tympani was discovered; but in their place is a flat surface of bone, which presents two fissures, one very narrow, with a direction forwards, and a second, three or four lines in length, and from half to three-quarters of a line in breadth, commencing at the anterior and inferior part of the other fissure, with a direction downwards and slightly backwards. This fissure is covered by

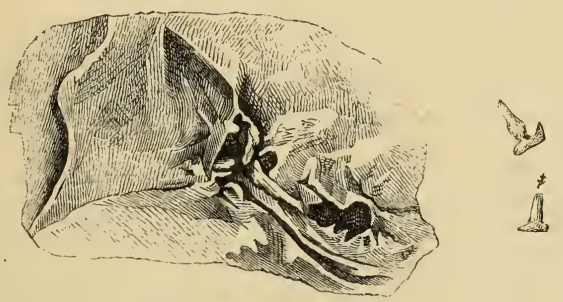
a membrane. The whole of the tympanic ring is absent, so that the mastoid and squamous portions of the temporal bone are only parted by these fissures, the lower of which seems to represent the Glasserian fissure and the external meatus united into one.

THE RUDIMENTARY MEATUS AUDITORIUS EXTERNUS OF A CHILD, IN THE FORM OF A FISSURE POSTERIOR TO THE CONDYLOID PROCESS.

The membrane which covers the fissure appears to be the analogue of the membrana tympani. The zygomatic process of the temporal bone is represented by a small osseous layer developed in the middle of a ligament, which extends from the external part of the squamous portion to the orbit; the malar bone is absent, the external part of the orbital circle being formed by a ligament connecting the superior maxillary and frontal bones.

Upon removing the membrane just described, a cavity was observed lined with mucous membrane; this is evidently the cavity of the tympanum, but so very much smaller than natural, as itself to resemble somewhat a fissure in the substance of the bone. It measures two lines in its vertical diameter, two and a half from before backwards, and about half a line from without inwards. This cavity contains two bones which are the analogues of the malleus and the stapes. The former consists of a narrow process directed upwards, and a globular body below, from which another process is directed inwards; but it has no connexion with the stapes to which it is

superior. The stapes, instead of its two crura, has a process flattened above and below, and about three-fourths of a line in length; to the inner extremity is attached the base, firmly fixed in the fenestra ovalis, while the outer extremity is slightly attenuated and presents no articulating surface. Over the stapes, and having a direction from above downwards and backwards, the portio dura nerve is seen unsurrounded by bone, but in contact with the mucous membrane of the tympanum. The tensor tympani muscle is in a natural state, as is also the Eustachian tube which opens into the anterior part of the tympanic cavity. The stapedius muscle is absent; the auditory nerve, cochlea, vestibule, and semicircular canals appear in all respects healthy.



THE TYMPANIC CAVITY, WITH THE EUSTACHIAN TUBE, OPENING INTO ITS ANTERIOR AND INFERIOR PART. THE TWO OSSICLES, DETACHED FROM EACH OTHER, ARE TO THE RIGHT.

The healthy state of the labyrinth would lead the surgeon to expect that sufferers from this deformity might hear some sounds; but considering the absence of an external meatus and membrana tympani, and the imperfect state of the tympanic cavity, the comparatively large amount of hearing enjoyed must be a source of surprise. In the following case there is every reason to suppose that the condition of the ears was similar to that just detailed; yet the power of hearing was much more acute than in many instances in which the ear is perfectly developed, but in which there exists some thickening of that part of the apparatus essential to hearing.

Case. Congenital malformation of both ears, and absence of the meatus auditorii.—Miss A. J., aged 22, consulted me in 1851, on the recommendation of Dr. Theophilus Thompson. On examination, a very small fold of integument, in which was a delicate portion of cartilage, represented each external ear.

The only vestige of the meatus auditorii was a very slight depression on each side, at the floor of which firm bone was felt. She heard the voice perfectly when spoken to loudly within a foot of the head, and best when the voice was directed towards the vertex of the head. She has a slight impediment in her speech, and her face is short and square-shaped; the

RUDIMENTARY EXTERNAL EARS.

zygomatic process appears to be undeveloped. When she attempts a forcible expiration with close nostrils, she feels a sensation of pressure in both ears. Does not hear so well during a cold. Three months previously a surgeon had made a crucial incision over the depression in the left ear, but no meatus auditorius was found. The patient thought she heard slightly better while the surface was kept open, but it was found impossible to prevent it from healing. I advised that no further operation should be performed, and that she should rest content with the amount of hearing she possessed. She died about two years afterwards, but it was found impracticable to obtain a post-mortem examination.

In some instances there has evidently been a co-existent abnormal development of the labyrinth, and the patients have been wholly deaf from birth; it is gratifying, however, for the surgeon to be able to assure the friends of infants respecting whom he may be consulted, that, as a general rule, there is a sufficient development of the organ for educational purposes and the ordinary intercourse of life. Thus one of the cases seen by Dr. Allen Thomson was a boy who went on messages for his father, a butcher. He could join in the conversation of those with whom he was intimate; and even a stranger could communicate with him by employing slow, distinct, and rather loud

articulation. A girl of only moderate intelligence, partly from weakness and partly from imperfect hearing, nevertheless understood what was said to her if spoken slowly and distinctly, and always answered by speech. Attempts to improve the hearing in similar cases by means of operations have invariably been unsuccessful; first, because, as a rule, there is an entire absence of meatus and membrana tympani; and secondly, because it has been found impossible to keep the aperture in the integuments from closing. In most cases of deformity of the external ear and meatus, a peculiar square shape of the face has been observed, the lower jaw being very short; and there is also not unfrequently imperfect speech and deglutition. Thus in an infant, a month old, seen in consultation with Mr. Roberts, of St. John's Wood, in 1853, the meatus auditorii being entirely absent, and the auricles only partially developed, the chin receded much more than natural, and there was a not unfrequent regurgitation through the nose of the contents of the stomach during eructation.

Supernumerary ears.—Cases have been recorded in which more than two ears have existed. Mr. Wilde says, that Cassebohm relates the case of a child with four ears; two placed naturally, and two lower down in the neck: in this instance there were two petrous portions to each temporal bone.

II. *Inflammations of the external ear.*

The two kinds of inflammation to which the auricle is subject are erysipelas and eczema.

Chronic Erysipelas.—It is unnecessary here to speak of the acute form of erysipelas, since in its nature and treatment it does not differ from the same disease attacking other parts of the body. The chronic form of erysipelas, however, deserves attention on account of its frequency, the discomfort it produces, and its very tedious character. It sometimes originates in the acute form of the disease, and often remains during many years. By degrees the auricle becomes hypertrophied and hardened, the meatus not unfrequently closed, and the ear loses its natural form, its surface being exceedingly tender. This affection generally occurs in females beyond the middle period of life.

Case.—C. F., aged 49, admitted under my care at the St. George's and St. James's Dispensary in 1849. She complains of much tenderness in both external ears, which, on examina-

tion, are observed to be red and very much thickened; the integument and subjacent cellular tissue of the right ear are hardened, and the auricle scarcely presents the general form of the natural organ.

The patient's health was much deranged. A solution of nitrate of silver, two grains to the ounce, was applied to the ear, and mild preparations of steel were administered. Under this treatment the tenderness of the ear greatly diminished.

Chronic Eczema, like chronic erysipelas, is most frequently found in females beyond forty years of age in whom there is some constitutional debility; it is, however, often met with in children. It is generally accompanied by extreme irritation of the auricle, which is of a deep-red colour, and often very smooth and shining. Scales of epidermis are seen adhering to some parts, and from others a thin discharge exudes. In some cases, especially in adults, the dermis is hypertrophied, and the auricle loses its natural aspect. If neglected, it is liable to extend into the meatus, the dermoid layer of which also becomes red and sensitive, and sometimes tumefied, although not unfrequently no tumefaction is apparent; the dermoid layer of the meatus throws out a discharge very similar to that formed on the external ear; and sometimes the epidermis collects in quantities so large as to obstruct the canal, and give rise to those symptoms of pressure on the membrana tympani which will be more particularly alluded to under the diseases of the meatus. The treatment of chronic eczema is very similar to that of chronic erysipelas. Frequent ablutions with tepid water, combined with emollients, should be practised in the early stages of the affection, when the skin is very sensitive, and the latter should be protected from the air by oiled silk, or very thin vulcanized India-rubber. Afterwards mild astringents are to be used, and, as Mr. Wilde recommends, a solution of gutta percha in chloroform may be painted over the surface several times until a complete coat has been formed; which is to be renewed from day to day as often as it peels off. The head should be kept cool; and instead of the ears being studiously covered by layers of warm material, they should be exposed as freely as possible, and very soft pillows avoided. The meatus ought to be frequently syringed with tepid water, for the purpose not only of removing the dead cuticle and discharge, but also of soothing the irritable dermoid

membrane. The introduction into the meatus of ear-picks and other foreign bodies, for the purpose of allaying the itching of the tube, must be studiously avoided; but if the itching becomes very distressing, a vapour-bath and hot injections should be resorted to. In later stages of the affection, when both dermis and epidermis become thicker than natural, the unguentum zinci or the unguentum hydrargyri nitratis may be employed. In addition to local applications, constitutional remedies should be employed. In adults any derangement of the general system should be attended to, alterative medicines administered, and great attention to diet enjoined, as well as abundant exercise in the open air. In children these constitutional remedies require to be still more sedulously used, and where there is a tendency to glandular enlargement, sea or country air may be advantageously recommended.

In addition to the two kinds of inflammatory disorder just noticed, the auricle is sometimes subject to a chronic inflammation, the seat of which appears to be the cartilage or its immediate investment: it is characterised by slight congestion and by extreme sensibility upon pressure. The auricle is also often the seat of chronic inflammation accompanied by excoriations; but frequent ablution with tepid water and the use of mild astringents generally effect a cure.

III. *Cysts, Tumours, Deposits, and Malignant Diseases.*

Cysts.—The only kind of cyst to which the external ear is subject, is that formed by an effusion of blood between the cartilage and the integuments. It has most generally been found in insane persons; and according to my friend Dr. Thurnam, of the Wilts County Asylum, who has paid particular attention to the subject, and who has favoured me with his experience upon it, it is not now so prevalent as formerly. This he ascribes to the fact that less personal violence is now used. It has been thought by some to be peculiar to the insane; such, however, is not the case, for a patient with this affection was admitted under my care, in the year 1852, at St. Mary's Hospital, and one, if not two, other cases of the kind have presented themselves to me.

This disease, called by Dr. Stiff,* Hæmatoma Auris, is divided by him into four stages.

* Medico-Chirurgical Review, January, 1858.

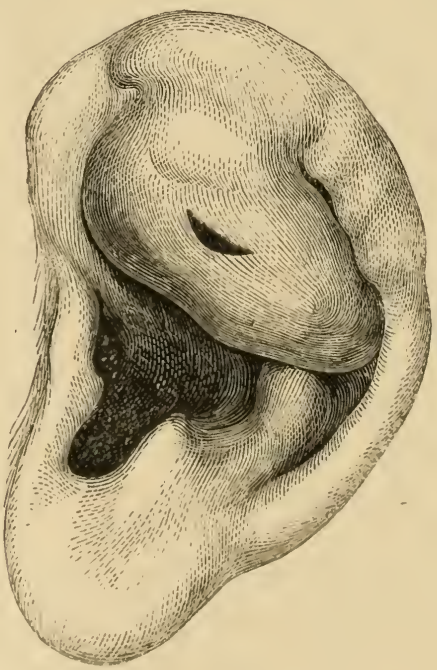
1. The stage of hyperœmia, and probably chronic inflammation, as shown by the congestion and loss of the elasticity of the cartilage.

2. The stage of effusion; an apoplectic layer is suddenly formed, causing obliteration of the ridges and depressions of the ear.

3. The cystic stage; in a comparatively short time absorption commences, the ridges reappear, but in altered shape. This stage may last for years.

4. Permanent induration, complete absorption of the fluid; and occasionally atrophy of the ear.

Dr. Thurnam calls this disease "Hæmatocele of the external ear." In a letter to me on the subject, he says: "In the first stage of this affection, I believe an effusion of blood exists between the folds of the integuments and around the fibro-cartilage of the ear: if punctured in this stage, there is a discharge of serum of the blood, mixed with coagulum. I think, however, the proper practice is, *not* to puncture in this early stage, but to



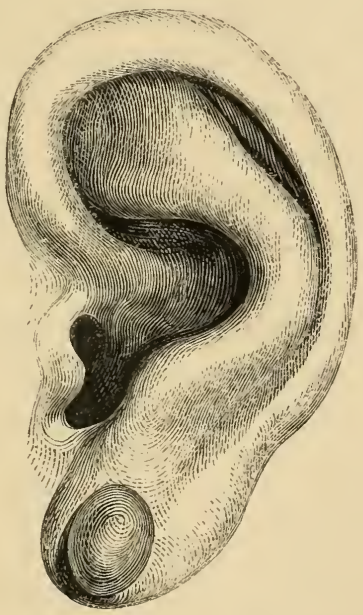
HÆMATOCELE OF THE EXTERNAL EAR (WILDE).

apply evaporating lotions. Even under this treatment, though still more if left to itself, the tumour often increases so as entirely to disfigure the ear, and produces a large hot swelling

of a livid red colour. At the end of a week or two, according to circumstances, I have passed, with a common or curved needle, a small seton through the long axis, pressing out the contents, which are now, in addition to their sanguineous nature, more or less purulent, and allowing the rest to escape gradually. At first the diminution of the tumour is trifling; but under the use of the seton it gradually subsides, and at the end of two or three weeks a certain amount of chronic thickening only remains. Where no such treatment has been adopted, the resulting deformity has been very marked, and has continued through life."

The patient who came under my notice, at St. Mary's Hospital, was a man aged 26, a boxer, who had received a blow on the ear a fortnight previously. The cyst was about the size of a small walnut; it had been punctured, and a transparent fluid was evacuated; it had, however, soon formed again. He did not return to undergo any treatment.

Tumours.—The lobule of the external ear is subject to hypertrophy, and to the development of tumours in its substance. Tumours are also developed from the surface of the cartilage, or from the cellular tissue covering it.



TUMOUR OF THE LOBULE (WILDE).

Mr. Wilde relates a case of tumour in the substance of the lobule. "M. S., a female, aged 19, has a hard, firm, ovoid

tumour occupying the centre of the lobe on each side, but largest on the left. It is of a stony hardness, and is quite distinct both from the cartilage above and the fleshy part of the lobe, which it appears to pass through. The skin covering it is smooth, and of a light pinkish hue, like that of a keloid tumour. It grew gradually from the orifice made for holding the earring, and has been several months attaining its present size. The tumour upon the opposite side, which also surrounds the hole made for the earring, is much paler in colour, and not larger than a garden pea. The girl states she experienced a great deal of pain and soreness in the wounds made in piercing the ears, and that about three or four months afterwards, she was obliged to remove the earrings, on account of the irritation they produced. The large tumour was dissected out, and the elliptical aperture left in the lobe brought together with sutures. It healed kindly, and the disease did not return. A section of the tumour exhibited a dense yellowish-white fibrous appearance, and was so hard that the nail made no impression upon it."

Gouty deposits are not unfrequent in the external ear.

Scirrhus.—Kramer, in his work on the Diseases of the Ear, devotes a section to the consideration of a disease which he entitles "scirrhous degeneration of the auricle." In its early stages, he describes its symptoms as analogous to those of erysipelas. As the disease advances, excoriation and ulceration of the auricle take place, and the cartilage is perforated and destroyed. The auricle becomes nodulated and misshapen; the nodules ulcerate. I have not met with the disease unless when complicated with disease of the petrous bone. Dr. Kramer cites three cases of supposed scirrhous degeneration: of these the following occurred in the practice of Dr. Fischer:— A countryman, when eight years of age, perceived an itching, which depended on a scabby eruption of the head. This extended to the right ear, and its irritation being increased by roughly rubbing it with the hand, the skin was corroded. A redness and swelling of the ear, the certain attendants of inflammation, continued from that time, much encouraged by the plethora and strength of the individual. The disease now remained stationary for some years, but at the time of manhood it broke out afresh, and with increased intensity. During his

twentieth year, it had acquired so enormous an extent that the whole auricle was converted into a knotty, deformed, and lumpy mass, in which the natural projection could scarcely be detected. At the anterior and inferior extremity of the antihelix the degenerated mass had begun to suppurate. Dr. Fischer cut away with a knife the whole degenerated ear, and the wound healed in less than six weeks.

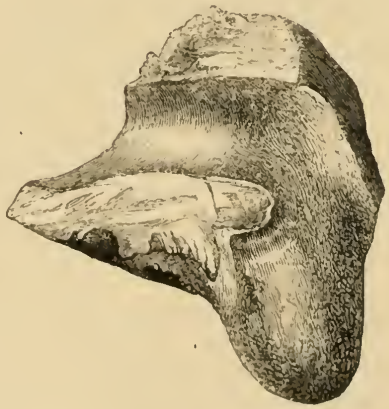
CHAPTER III.

THE EXTERNAL MEATUS—ITS EXPLORATION.

ANATOMICAL OBSERVATIONS—OSSEOUS MEATUS—MEMBRANOUS MEATUS—OBJECTS IN EXPLORING THE MEATUS—MEANS OF EXPLORATION—LAMPS—SPECULUM—MODE OF EXPLORATION.

The external auditory meatus is a tube formed partly of cartilage and partly of bone. It extends in a transverse direction from the concha of the outer ear to the membrana tympani internally. Its length varies in the adult from an inch and a quarter to an inch and a half.

The Osseous Meatus.—There is a convexity about the middle of the lower wall of the osseous meatus which causes a slight central contraction of the calibre of the tube; and this convexity, combined with a similar one in the anterior wall, often prevents the anterior and inferior fourth or fifth of the membrana tympani being visible to the surgeon during his



A VERTICAL SECTION OF THE LEFT MEATUS EXTERNUS, FROM WITHOUT INWARDS.

exploration. The superior and posterior walls are slightly concave: the anterior wall and floor of the meatus extend three or four lines further inwards; and as the membrana tympani is attached to the inner extremity of each wall, hence

the oblique position of this membrane. The upper wall has intimate relations with the cerebral cavity; the posterior is separated by a thin lamina of bone only from the mastoid cells; the anterior wall forms part of the glenoid cavity and the fossa parotidea. The outer orifice of the osseous meatus is of an oval shape, its longer axis being from above downwards, and slightly backwards. The anterior and inferior parts of the orifice are rough and scabrous, the fibro-cartilage of the meatus being firmly inserted into them. The posterior and superior parts of the orifice are smooth, and perforated by numerous orifices for the transmission of vessels. The inner orifice of the meatus is round, and in the groove of its margin the circumference of the membrana tympani is inserted.

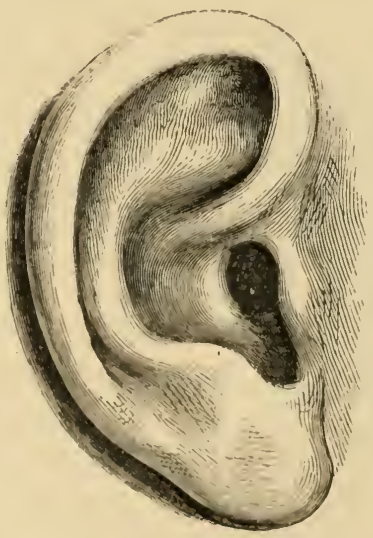
The diameter of the external meatus varies much. In some adults, it is so large as to admit the introduction into it of the end of the little finger for a considerable distance, and the membrana tympani may be seen by means of the ordinary daylight, without the lobe being drawn back. In other persons, the meatus is so small as scarcely to admit a common goose-quill. The large size of the meatus depends generally upon the original conformation of the bony tube, but its contracted state is often the result of osseous development, or a thickened condition of the dermis, or the presence of bony tumours.

The membranous meatus consists of the following laminæ, beginning internally:—1st, the epidermis; 2nd, the dermis; 3rd, the periosteum. Between the dermis and the periosteum of the outer portion of the tube are placed fibro-cartilage, cellular tissue, and ceruminous glands. The *epidermis* forms a cul-de-sac, which covers the whole of the outer surface of the dermis, and is prolonged over the outer surface of the membrana tympani, of which it forms the outermost lamina. In the outer part of the tube the epidermis is thick, and is perforated by the ducts of the ceruminous glands. Near to the outlet, it presents orifices for the passage of the hairs which frequently protect the entrance of the meatus. At the inner half of the tube, the epidermis is extremely thin, with a shining surface. The scales which compose the epidermis are constantly thrown off from the free surface of the membrane: they mix with the cerumen, and in the healthy ear are excreted with it.

The *dermis* also forms a cul-de-sac by being continuous with

the dermoid layer of the membrana tympani. Near to the orifice of the meatus, the dermis differs but little from that covering the cartilage of the concha, with the exception that it gives insertion, particularly in elderly persons, to numerous short strong hairs. More internally, the dermis is remarkable for its extreme sensibility, and gives passage to the ducts of the ceruminous glands. The outer half of the dermis is firmly connected, anteriorly and inferiorly, to the fibro-cartilage; posteriorly and superiorly, where there is no fibro-cartilage, the dermis is connected to the superior and posterior parts of the osseous meatus by loose cellular tissue, in which the ceruminous glands are placed. At the inner half of the tube, the dermis is intimately connected with the periosteum, the two membranes being frequently inseparable.

The outer half of the membranous meatus contains, in addition to the laminæ previously noticed, *fibro-cartilage*, which is continuous externally with that forming the external ear, and, internally, is attached to the rough margin of the osseous meatus by fibrous tissue, which admits of considerable motion taking place between the cartilage and the bone. The outer part of the fibro-cartilage of the meatus projects and forms the tragus. The fibro-cartilaginous meatus does not form a com-



THE ORIFICE OF THE MEATUS EXTERNUS, SHOWING ITS OVAL SHAPE.

plete tube, being deficient at its posterior and superior third, where the blood-vessels of the bone freely communicate with

those of the meatus. The shape of the *orifice* of the meatus, consisting of fibro-cartilage, is more oval than that of the osseous meatus, and is composed, anteriorly and inferiorly, of the fibro-cartilage, covered by the dermis, posteriorly of the anterior border of the concha, which projects slightly forwards. The superior part of the orifice does not contain any fibro-cartilage; but in the remaining portions, the dermis is connected with the fibro-cartilage by very dense cellular tissue. That the orifice of the meatus externus is oval is shown by simply introducing the index finger within it in the living subject. It will be found that the finger (itself of an oval shape) enters some slight distance, and that its anterior and posterior surface are in contact with the corresponding surfaces of the orifice; but if the posterior surface of the finger be directed upwards, and the anterior downwards, its entrance is impossible. The orifice of the external meatus is its narrowest part, and its cavity and the membrana tympani are guarded by the slight projection posteriorly of the tragus, while the posterior margin of the orifice projects slightly forwards. Thus the introduction of a foreign body is prevented by the flap of the tragus covering the orifice; and if that be pushed aside or penetrated, then the projecting posterior border of the orifice directs the body against the anterior wall of the meatus. This condition of the orifice of the meatus is also of great use in preventing the sudden rush of cold air to the surface of the membrana tympani, and the passage of water to it, when the head is immersed, or copious ablutions are practised. The projection of the tragus backwards, and of the cartilage forming the posterior margin of the meatus forwards, consequently gives a curved form to the tube, which curvature is increased by the direction of the osseous tube being first slightly forwards, then backwards, and, lastly, somewhat forwards again.

At birth, only the rudiments of the osseous external meatus are present: these consist of a delicate osseous ring, which, however, is incomplete at the upper fourth, where the surface of the temporal bone is smooth and slightly concave. The upper part of the membranous meatus rests on this portion of bone. The inner margin of the remainder is attached to the annulus auditorius; its outer surface is in contact with the adjacent tissues. As the child grows, the smooth superior surface is gradually developed

into the concave upper wall of the meatus, and from the osseous ring spring the anterior, posterior, and inferior walls.

THE OSSEOUS MEATUS EXTERNUS OF AN INFANT.

In the *exploration* of the meatus, the object of the surgeon is threefold.

I. To render the meatus as straight as is practicable.

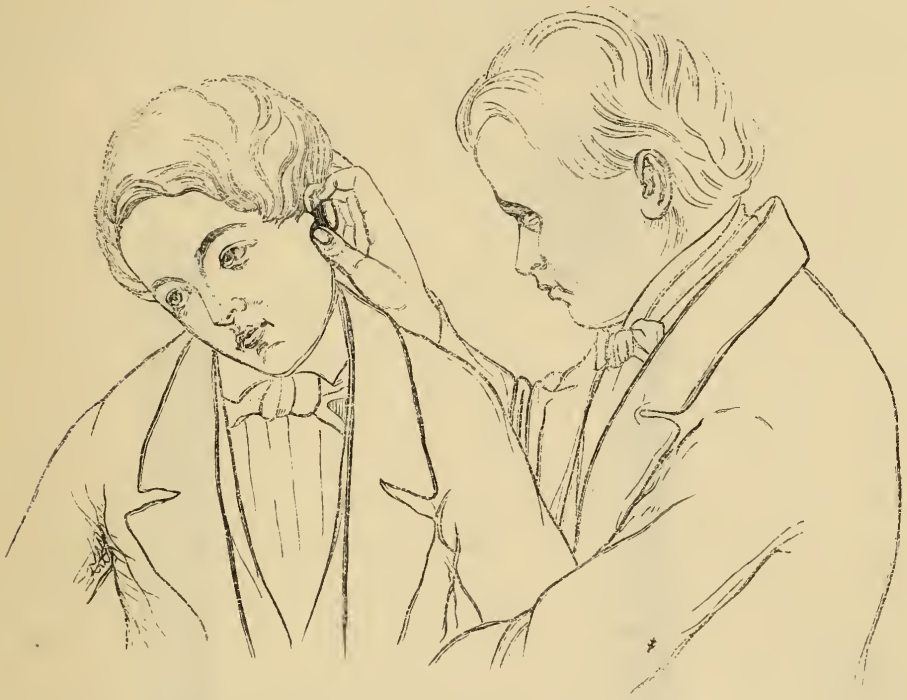
II. To dilate slightly the outer membranous and cartilaginous portion.

III. To throw as much light as possible on the walls of the meatus.

To straighten the meatus it is necessary to press the tragus forwards, and the cartilage forming the posterior wall of the meatus backwards. When the meatus is very large, this may be accomplished by simply pulling the outer ear backwards by the finger and thumb, at the same time that the tragus is pressed forwards by another finger; but this is better effected by the aid of the *speculum auris,* which at the same time dilates the orifice. Some writers have supposed that it is not desirable to use any instrument for this purpose; but the orifice of the meatus is generally so small that it is important to dilate it as widely as possible without causing pain, in order to allow the passage of a sufficient volume of the rays of light to permit the inspection of the surface of the meatus, and of that of the membrana tympani. That the orifice of the meatus is susceptible of being dilated is shown by placing the end of a finger in it, and then pressing it gently inwards, when the walls will be felt to yield slightly, and to embrace the finger firmly.

For the proper inspection of the meatus a strong light is required, which can be so thrown as thoroughly to illuminate the visible surfaces of the meatus externus and the membrana tympani. Sunlight is the best; but as its presence in our variable climate can rarely be made available, and as the surgeon must

be prepared to make his observations at all times of the day and night, and often on patients lying in bed, it is clear his usual resort must be to artificial light. By a careful use of this light,



THE MODE OF EXAMINING THE EAR BY AID OF SUNLIGHT.*

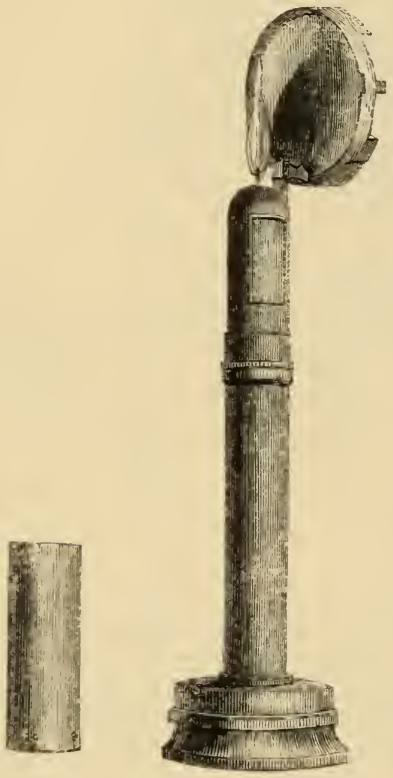
however, he may, with few exceptions, attain to such a knowledge of the condition of the surfaces illuminated as will suffice for his guidance.

There are two lamps which throw a good light into the meatus, M. Segalas' and Mr. Miller's.

Segalas' lamp is of very simple construction, but can only be used with gas. It consists of two vertical iron rods, the anterior of which is about four inches high, and surmounted by a gas burner which communicates with the vulcanised india-rubber gas tube. This vertical rod is connected by a horizontal rod, four inches long, with a second vertical rod about three inches high, to the summit of which is fixed a circular reflector about four and a half inches in diameter; and in the centre of which is an orifice for the surgeon to look through, about half an inch in diameter. Attached to the horizontal rod is a ball and socket-joint, and a handle and moveable piece by which the lamp may be held in the mouth, and thus both hands left at liberty.

* In this figure the head of the patient ought to incline more to the right shoulder.

Miller's lamp, called after its manufacturer, was first suggested by Dr. Chowne; but it has undergone great improvements in the hands of its maker. It consists of a wax candle, enclosed in a Palmer's spring tube, about six inches in length, standing upon a foot about two and a half inches in diameter



MILLER'S LAMP OPEN.

MILLER'S LAMP CLOSED.

and three quarters of an inch deep, so as to hold the reflector when not in use. For the top there is a cap which acts as an extinguisher, and also as a defence to the candle when carried about. This lamp will, I think, be found efficient and economical, not merely in cases of disease of the ear, but in all cases where a lamp is required.

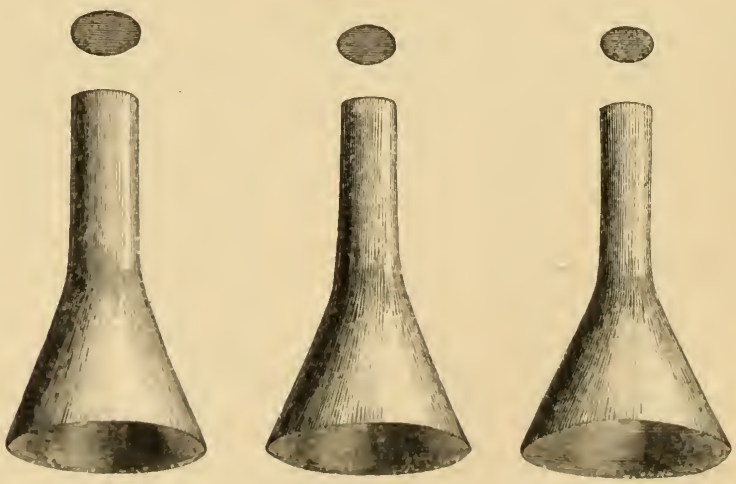
In addition to the lamp, *specula* are necessary for the examination of the ear.

Speculum auris.—Various complicated and somewhat expensive instruments have been invented for the purpose of straightening the outer half of the meatus, for slightly dilating it, and for concentrating the rays of the sun, or of an artificial light, on the surface of the tube and on the membrana tympani. The one in general use previous to the last ten years was the *forceps-speculum:* it is made of steel, and consists of

two handles or branches crossing each other, but having a strong spring between them; each of these branches is attached, at the extremity furthest from the handle, to half a metallic funnel, and when the handles are pressed together, the two halves of the funnel separate. It is used by placing the small extremity of the funnel in the outer part of the meatus, and then opening it so as to dilate the tube. The objections to the forceps-speculum, and indeed to all modifications of it, consist in its being cumbrous, expensive, and not efficient. Thus this instrument is too heavy to remain in the external meatus without being held; on account of its weight and size it cannot be used with delicacy, while a sensitive meatus is liable to be pained by it; further, it requires the exclusive use of one hand, so that it cannot be well employed during the performance of an operation, or the use of applications to the meatus or membrana tympani. Another great objection to the forceps-speculum is, that when the two portions of the funnel are separated in the meatus, two spaces are left between them, through which hairs or portions of epidermis and cerumen often project, and obstruct the passage of light.

To remedy some of the above defects, the *tubular ear-speculum* was invented by Dr. Gruber of Vienna, and introduced to the notice of English surgeons by Mr. Wilde, in his paper on Otorrhæa, published in 1844 in the *Dublin Journal of Medical Science*. Mr. Wilde describes it as consisting of "a small conical tube of silver, measuring about an inch and a half in length, five-eighths of an inch in width at the greater aperture, and varying from two to four lines in the clear at the small extremity." The interior and exterior of each extremity is polished, and both openings are circular. Two or three sizes are recommended. There can be no doubt that this speculum was a great improvement over any previously suggested; but upon comparing its shape with that of the tube it is intended to explore, two grave defects are detected. The first is the coniform shape of its small extremity; for the widest part of the speculum is introduced into the narrowest part of the tube, and its extremity projects into and obstructs that portion of the meatus which it is desirable should be free. With a speculum of this shape it is, secondly, very difficult to explore the whole of the meatus, and it is not sufficiently embraced by the meatus

to retain its position without being held. These disadvantages of the conical speculum were observed by the late Mr. Avery, who devoted so much time, and did so much to facilitate the exploration of the various mucous canals. He suggested that the narrower portion of the speculum, for about three-quarters of an inch, should be of the same diameter throughout. There remained, however, the other very serious defect in the tubular speculum of the *circular* form of its small extremity. As has been said, the surgeon can readily assure himself of the oval shape of the outer meatus, and that the anterior and posterior walls of the tube are flat and only slightly concave ; a form that also partially obtains in the bone. It is clear, therefore, that when a circular tube is introduced into this oval-shaped meatus, it may press against the anterior and posterior walls, and yet leave a considerable space above and below it unoccupied. As a rule, therefore, it is impossible by means of this form of instrument to obtain a view of more than a small portion of the meatus and membrana tympani at the same time ; and should the meatus be very small, the circular tube does not give passage to a sufficient quantity of luminous rays to enable the surface of the membrana tympani to be discerned. Another disadvantage of the circular speculum is, that the pressure of its convex surface against the anterior and posterior walls of the meatus, which are nearly flat, is liable to



A SET OF SPECULA FOR THE PURPOSE OF EXAMINING THE EXTERNAL MEATUS.

produce pain, especially where the tube is small. It is therefore evident that the part of the speculum inserted into the meatus

should be of an oval shape. This modification of the tubular ear-speculum was suggested by me in a paper in the *Lancet*, published in August, 1850; since which time most of these instruments have, I believe, been made of this shape, and have been found to answer every purpose for which a speculum auris can be required. In order to hold the speculum more firmly, it is desirable that the expanded portion should be somewhat flattened; and this flattening should be at right angles with that of the smaller extremity. A set of three or four specula should be in possession of the surgeon. It has been suggested that the tubular ear-speculum should be made of glass silvered; but the thickness of the material would occupy too large a portion of the cavity of the meatus.

Mode of examination.—After the preliminary investigation has been conducted, the patient being as nearly as possible on a level with the surgeon, the latter, taking the lamp in one hand, should feel and inspect the external ear and the orifice of the meatus, without the use of the speculum. Having done this, a speculum adapted to the size of the meatus is to be taken in hand, and introduced into the orifice of the meatus, care being taken that the long diameter of each coincides. If the speculum enters very easily, and there appears to be room for a larger one, the next size should be selected, and the orifice fully dilated; for in all cases, the larger the speculum used the greater will be the quantity of luminous rays entering the tube, and the more complete the view of the meatus and membrana tympani. The speculum, having been introduced, is to be pressed slightly backwards for the reasons I have mentioned, and then, by means of the lamp in the other hand, the rays of light are to be directed successively on the several walls of the meatus and on the membrana tympani. The size of the different parts of the tube, the quantity, colour, and position of the cerumen, if present, should be noted; if absent, the state of the part of the tube in which it naturally exists, and the degree of vascularity of the dermis lining the inner half of the meatus.

A considerable degree of care is required in the examination of the meatus in the infant and child. The total absence of the osseous meatus in the former, and its very limited size in the latter, should always be borne in mind, or the surgeon, when he introduces the speculum, is apt to press upon the membrana

tympani. In many cases it is necessary only to open the orifice of the meatus, when the membrana tympani is at once seen without the introduction of the speculum any further.

THE SURGEON EXAMINING THE EXTERNAL MEATUS BY MEANS OF MILLER'S LAMP AND THE TUBULAR SPECULUM.

CHAPTER IV.

THE EXTERNAL MEATUS (*continued*).

ON FOREIGN BODIES AND ACCUMULATIONS OF CERUMEN IN THE MEATUS.

FOREIGN BODIES IN THE MEATUS — MODE OF REMOVAL — CASES — CERUMINOUS GLANDS—THEIR DISEASES—ACCUMULATIONS OF CERUMEN—THEIR CAUSES—TABLE OF TWO HUNDRED CASES IN WHICH THE CERUMEN WAS REMOVED—SYMPTOMS—EFFECTS—TREATMENT—MODE OF REMOVAL—THE SYRINGE AND ITS USE—CASES.

FOREIGN BODIES IN THE MEATUS.

Foreign bodies are frequently introduced into the outer meatus. Among those which have fallen under my own notice may be named beads, slate pencil, leaves, a shell, a pea, sealing-wax, a percussion cap, a pin, a piece of paper, seeds of grass, tobacco, wool, cotton wool, human hairs, bacon, lint, camel's-hair pencil, and camel's-hair. When a body is put into the meatus by design, it is either done by a child in play, or by an adult for the purpose of medical treatment, or an alleviation of the itching of the tube. When a patient is suspected of having a foreign body in the ear, the first step of the surgeon is to make a careful inspection of the tube in sunlight or with the speculum and the lamp, with the view of ascertaining whether there really is anything present. In a great number of cases, having explored the whole of the meatus, and seen the membrana tympani, he will be able to assure the patient or the friends that no foreign substance is there. For want of this pre-inspection, lives have been destroyed in attempting to extract from the ear imaginary bodies which had never lodged there. Medical men are not

generally aware of the impunity with which a foreign substance may continue for a time in the meatus. It is not uncommon to find a mass of hard cerumen in contact with the whole of the meatus and with the outer surface of the membrana tympani, without causing any pain or inflammation; and I have frequently removed other substances, as beads, pebbles, &c., which had been either in contact with the membrana tympani or in its immediate vicinity, without causing any painful irritation. Nor is this remarkable when it is remembered that the meatus and outer surface of the membrana tympani are a continuation of the outer skin, and, like it, covered with a layer of epidermis. The meatus and membrana tympani are extremely sensitive when pressed upon by hard or rough substances; but soft, smooth bodies may be gently pressed against them without exciting pain. Thus the artificial membrana tympani, made of vulcanized india rubber, is placed against the outer surface of a perforated membrana tympani without producing any unpleasant sensation.

When a foreign body has been detected in the external meatus, it should be removed as soon as possible. The syringe and warm water are, as a general rule, quite sufficient to remove all rounded solid bodies. I have succeeded in extracting beads and other hard substances which appeared to be impacted in the meatus, by means of the syringe only, though a good deal of time is occasionally required. It may at times be useful to move the body slightly by means of a probe a little bent downwards, so as to facilitate the passage of the water to the back of it; for the mode by which the syringe acts, is in forcing the warm water inwards behind the foreign body, and thus gradually expelling the latter outwards. Mr. Wilde and other writers recommend the use of the curette, spatula, or forceps, in the extraction of extraneous substances from the meatus: but I have rarely been obliged to use any of these instruments, and resort to them should be avoided if possible. Dieffenbach, who advocated the use of a curved director, or curette, must have met with cases showing the practice to be dangerous; for he says, "Should violent bleeding supervene, and there be no likelihood of completing the operation at one sitting, cold and afterwards warm applications are to be resorted to, to prevent suppuration."

It is also almost impossible to pass a curette between the extraneous substance and the meatus without impelling that substance inwards, in which case it is very apt to be pressed *forcibly* against the membrana tympani, and cause inflammation. Cases are sometimes met with in which the most lamentable results have followed attempts at removing foreign bodies by instruments. Death itself has not unfrequently happened; and where the life of the patient has been spared, the ear has sometimes been destroyed and the *portio dura nerve* paralysed.

Should a patient apply for relief who has much inflammation and tumefaction of the meatus, consequent perhaps upon attempts previously made to remove the body by instruments, the best course is to apply leeches and fomentations to subdue the inflammatory symptoms, before attempting the extraction by the syringe.

In certain cases the presence of a foreign body in the meatus gives rise to coughing, and even to vomiting; symptoms which seem traceable to irritation of the auricular branch of the pneumo-gastric nerve. A patient under my care, with a portion of dead bone in the meatus, suffered under a cough, which no treatment subdued, but which disappeared as soon as the bone was removed. In a notice of Professor Romberg's work, in the *British and Foreign Medical Review*, Vol. XVII., it is stated that Arnold met with a case of chronic vomiting in a child, which long resisted all medical means, but which was cured by removing a bean from each of the child's ears.

There are substances of a different character from those already alluded to which are not so easily removable by the syringe. These are wool, cotton wool, tobacco, leaves, paper, and similar soft materials, which expand in the tube and perfectly fill it. If the syringe fails to remove these bodies, they can be seized with the lever-ring forceps, with which they can be easily withdrawn.* Insects sometimes enter the meatus, and are apt to cause more irritation than the presence of solid bodies. If they touch the membrana tympani, they cause extreme sensitiveness of it, and spasmodic contraction of the tensor tympani muscle. The use of the syringe, or, if that be not at hand, the pouring of a little warm water into the ear, affords instant

* See a description of this instrument in Chapter VI.

relief. Foreign bodies which press upon the outer surface of the membrana tympani are apt to force the chain of bones inwards, and thus press the stapes towards the vestibule, causing the peculiarly distressing symptoms of giddiness and confusion in the head which not unfrequently attend upon an accumulation of cerumen. These cease as soon as the foreign body is extracted.

There is little known as to the effect of narcotics introduced into the external auditory meatus: but I have every reason to believe that the narcotic property of a piece of tobacco in the meatus was the cause, in one instance, of very serious cerebral derangement.

It is probable that, in the following case, the foreign body escaped spontaneously.

M. S., aged 9, was brought to me by a medical man, in January, 1852. He stated that, on the previous evening, the mother of the child had seen her put a bead into the right ear; that he himself had seen what he supposed to be the bead, but had been unable to extract it by the forceps. By means of the lamp the surfaces of the meatus and membrana tympani were seen, and the dermis throughout was much congested, especially near the orifice where the forceps had been applied, but no foreign substance could be detected.

CASES OF FOREIGN BODIES REMOVED FROM THE EXTERNAL MEATUS.

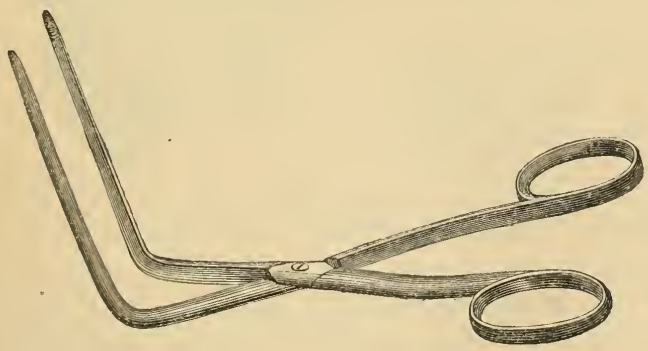
Case I. *Slate-pencil in the ear of a child.*—J. S., aged 7, was brought to me at the St. George's and St. James's Dispensary, on November 28th, 1849, her mother stating that she had pushed a piece of slate-pencil into the right ear. She had not complained of pain, and had slept well. Upon examination, by means of the speculum and lamp, a rough piece of slate-pencil was observed lying on the floor of the meatus, one end being apparently in contact with the membrana tympani, while the other looked towards the orifice of the meatus. It was easily removed by the syringe and warm water, and found to be nearly half an inch long, and a quarter of an inch broad. The membrana tympani was red, the blood-vessels of its dermoid layer being distended. The patient did not complain of pain, and in a few days the membrana tympani was healthy.

Case II. *A percussion cap in the ear for fifteen years.*—C. E.,

aged 26, was admitted at St. Mary's Hospital in November, 1852. She said that lately she had felt somewhat deaf in both ears. Upon examination, a mass, like hardened wax, was observed near the orifice of the left meatus. It was removed by the syringe, and proved to be a percussion cap surrounded by wax. The patient said that she remembered, when about 11 years of age, she put a cap into her ear, but she believed it had been taken out, and had never thought of it since. The membrana tympani was concave, the Eustachian tube natural, and the power of hearing was nearly gone. Right ear: hearing distance seven inches, membrana tympani dull, concave; Eustachian tube natural. It appears that the thickening of the right membrana tympani had recently caused a dulness of hearing in that ear: the left ear had doubtless been useless for some time: but so long as the right ear remained perfect, the defect in the left was not observed.

Hairs are apt to collect in the meatus; they either enter in small pieces while the hair is being cut, or those growing at the orifice fall inwards: great irritation is caused by them.

Case III. *A collection of hairs in the external meatus.* — W. S., aged 69, complained of an extremely unpleasant crackling in the right ear whenever he moved the head or ear. It came on two months before seeing me, after bathing in the sea: and he had had a similar attack some years previously, which had subsided spontaneously. The hearing distance was three inches. A large mass of short hairs was syringed out of the ear; the symptom of crackling at once disappeared, and the hearing distance became two feet. Another gentleman from the same cause was troubled with excessive itching.



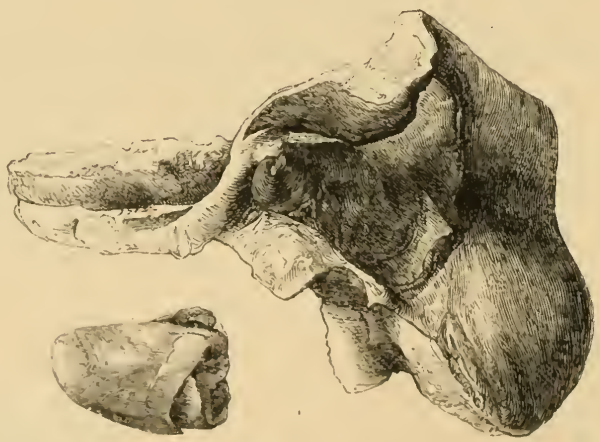
RECTANGULAR FORCEPS.

Case IV. *A pin impacted in the meatus.*—A. R., a servant, aged 35, came in great fear and in some pain, complaining that

while picking the left ear with a pin she had dropped it into the ear, and was unable to remove it. The head of the pin was seen to lie close on the membrana tympani at its lower part, and the point seemed to be inserted in the membranous meatus. The syringe proved ineffectual, and I therefore had to remove it with the rectangular forceps, an instrument of great utility where the extraneous substance cannot be otherwise removed. On attempting to withdraw the pin, I discovered that its point was firmly fixed in the dermis, and that the only way to extricate it was to seize it by the middle, push it gently inwards against the membrana tympani, and then suddenly draw it out.

Cotton wool.—In one case a portion of cotton wool had been in the right ear for ten years without producing any other symptom than a feeling of fulness. In the following case, where it rested on the membrana tympani, symptoms similar to those of pressure on the brain were very decided.

Case V. *Cotton wool in the meatus.* — The Rev. O. M., aged 55, consulted me in 1849. Since an attack of measles when a child, has had a discharge from the left ear; and has been accustomed to push a portion of cotton wool into the meatus. Has lately suffered from giddiness and a sensation of weight on the head; which symptoms his medical advisers thought were



THE EXTERNAL MEATUS GREATLY DILATED BY A PIECE OF COTTON WOOL; THE LATTER IS SEEN BELOW, AND TO THE LEFT.

produced by derangement of the stomach, as during attacks of dyspepsia he was decidedly worse. Upon examination a large quantity of cotton wool was observed in the meatus in contact with the membrana tympani: it had evidently been pushed in

by other portions which had been thrust upon it. The cotton was removed by means of the syringe, and was found to have closed an orifice in the membrana tympani. After the removal of the cotton, the attacks of giddiness wholly subsided.

In a dissection, of which a drawing is subjoined, I found a piece of cotton wool in the meatus, where it had probably remained for many years; and it had so largely dilated the bony meatus, that the index finger could be passed in as far as the membrana tympani.

Case VI. *A shell in the meatus; removal by instruments; paralysis of the portio dura nerve.*—Miss A., aged 14, consulted me, in May, 1853, on account of complete deafness of the right ear and paralysis of the right side of the face. Her father stated that eight years previously she had, in play, put a small shell into the ear; that the surgeon, in endeavouring to remove it, forced it deeper into the ear, breaking the shell, and causing intense pain. After its removal there was much discharge from the ear, and in a few days the muscles of the right side of the face lost their power, which they have not regained. Upon examination there was no vestige of the membrana tympani; the mucous membrane of the tympanum was very thick and red, and there was not the slightest power of hearing.

Case VII. *Tobacco in the meatus; pain and numbness in the head; partial stupefaction, inability to walk straight.*—M. B. S., aged 50, applied for relief in 1843. He stated that for four months he has had pain and a sensation of numbness in the right side of the head, which feelings are much aggravated at times. He also complains of giddiness, and sometimes reels across a room; at others he is obliged to sit down, feeling quite oppressed and stupified. He has also suffered from indigestion. Upon consulting a medical man, he was treated by cupping, purgatives, &c., but without relief. Upon examination of the right external meatus, a considerable quantity of black matter was seen, which was easily removed, and was found to consist of tobacco in a moist state, mixed with cerumen and wool. The next day the head symptoms were much diminished; in a few days they wholly disappeared, and the patient remained free from them. The tobacco had been introduced into the meatus a short time before the attack on account of toothache. The mass was soft, and so loosely packed that it appears probable the symptoms

were caused by the narcotic principles of the tobacco, rather than by its pressure on the membrana tympani. In cases of pressure, too, the symptoms disappear at once on the removal of the cause; whereas, in the present instance, they subsided slowly.

THE CERUMINOUS GLANDS AND THEIR DISEASES.

The ceruminous glands surround the outer half of the membranous meatus with the exception of the portion situated within a line or two of the orifice. They are contained in the cellular tissue beneath the dermis, on the surface of which the ducts open. Kölliker has recently shown them to be modifications of the sudoriferous and not of the sebaceous glands, as was previously supposed. The cerumen secreted by these glands forms, in the perfectly healthy ear, a band about half an inch in length, and half a line thick. This band should be of a consistence just sufficient to enable it to retain its position, at the same time that it can collect the small particles of dust, &c., which float in the atmosphere, and prevent their accumulation on the surface, or in the vicinity of the membrana tympani. Two other functions ascribed to the cerumen are, that by its bitter taste it prevents the ingress of insects; and that in some peculiar manner it assists the power of hearing. Its principal use is unquestionably to arrest and collect the particles of dust. Its bitterness may possibly deter the entrance of insects; but the idea that it mechanically assists in collecting or conducting the sonorous vibrations to the labyrinth, or that it is of any use, in fact, in the actual process of hearing, is, in my opinion, quite erroneous. No doubt its absence is very frequently accompanied by a diminution of the hearing power; but this absence appears rather to result from the sympathy which exists between these glands and the deeper structures of the ear. Very often, when these return to their normal state, the ceruminous glands again pour out a healthy secretion. The most convincing proof that the cerumen does not mechanically assist in the function of hearing is, that in many cases, when the ceruminous glands alone are affected, and their secretion consequently arrested, no diminution in the hearing power can be detected even by the use of the most delicate tests; and cases must frequently occur to medical men, where there has been a long-continued discharge from the surface of the dermis, no cerumen being secreted, without perceptible diminution of the hearing power.

It is also well known that the entire removal of the ceruminous secretion does not impair the hearing power; and in no case of deafness has it been shown that the introduction of cerumen or of any substance to supply its place, or even the promotion of its healthy secretion under the influence of stimulants, has in the least degree improved the hearing. Indeed, if the peculiar properties of soft cerumen be considered, it must be manifest that its function would be rather to absorb superabundant sonorous undulations than to increase their intensity. The natural method whereby the cerumen when it has performed its duties is expelled from the ear, is the action upon the external meatus of the condyloid process of the lower jaw, during the movements of mastication and articulation. By these movements, the cerumen is brought quite to the orifice of the meatus, whence it either falls out in small particles, or is removed by the towel.

Diseases of the Ceruminous Glands.—The ceruminous glands sometimes pour out a too abundant secretion, which is either of a light brown colour and softer than natural, or hard and dark coloured: it may also be entirely absent. When soft and semi-liquid, it is generally found in young patients having a tendency to glandular enlargements, and in whom the dermis of the meatus is hypertrophied: thus, without any accumulation beyond that which adheres to the walls of the meatus, the cavity is nearly filled with cerumen. It is, however, generally found in a state harder than natural; and this condition, by preventing its free escape from the ear, gives rise to that very common affection, accumulation of cerumen in the external meatus.

Collections of Cerumen.—Cerumen accumulates in the external meatus from two different causes: *one*, a primary affection of the ceruminous glands; *the other*, a secondary and sympathetic derangement of the deeper-seated cavities. Thus, while in a large number of cases the removal of the accumulated cerumen is productive of immediate relief to the deafness; in others, the hearing is only partially or not at all benefited by the operation. In order to ascertain the numerical relation between the cases of accumulation that are *cured*, and those that are only relieved, by the use of the syringe, I have arranged in a tabular form the results of one hundred consecutive cases that have occurred in my private practice.

TABLE SHOWING THE EFFECT ON THE POWER OF HEARING OF THE REMOVAL OF AN ACCUMULATION OF CERUMEN IN ONE HUNDRED CASES; THE NORMAL DISTANCE OF TESTING WATCH BEING THREE FEET.

AGE.	HEARING DISTANCE BEFORE REMOVAL.		HEARING DISTANCE AFTER REMOVAL.	
	Right Ear.	*Left Ear.*	*Right Ear.*	*Left Ear.*
22	1 inch	8 inches	18 inches	18 inches
22	normal: no cerumen	half an inch	normal	normal
32	7 inches	crack of nails	12 inches	7 inches
70	contact	contact	contact	contact
33	half an inch	half an inch	normal	normal
35	2 feet	half an inch	normal	normal
45	contact	half an inch	2 inches	2 inches
15	half an inch	3 inches	normal	normal
44	normal: no cerumen	half an inch	normal	normal
59	1 inch: no cerumen	crack of nails	1 inch	crack of nails
25	crack of nails	3 in.: no cerumen	1 inch	3 inches
18	4 inches	half an inch	normal	normal
29	5 inches	normal: no cerumen	normal	normal
8	contact	contact	3 inches	contact
74	half an inch	half an inch	half an inch	half an inch
49	6 inches	6 inches	6 inches	6 inches
53	crack of nails	2 in.: no cerumen	4 inches	2 inches
28	half an inch	normal: no cerumen	normal	normal
26	1 inch	half an inch	8 inches	7 inches
26	half an inch	2 inches	normal	12 inches
49	9 inches	1 inch	9 inches	1 inch
19	7 inches	1 inch	7 inches	24 inches
32	quarter of an inch	half an inch	normal	normal
53	normal	half an inch	normal	normal
30	half an inch	10 inches	6 inches	normal
—	2 inches	1½ inch	2 inches	half an inch
41	18 inches	5 inches	18 inches	8 inches
65	contact	contact	2 inches	2 inches
27	pressure	pressure	half an inch	3 inches
44	4 inches	pressure	6 inches	3 inches
25	24 inches	1 inch	normal	3 inches
40	pressure	normal	normal	normal
65	crack of nails	crack of nails	2 inches	contact
27	12 inches	contact	normal	normal
27	18 in.: no cerumen	pressure	18 inches	18 inches
70	pressure	pressure	1 inch	1 inch
56	normal	pressure	normal	7 inches
—	2 inches	2 feet	normal	normal
20	2 inches	2 in.: no cerumen	2 inches	2 inches
53	24 in.: no cerumen	contact	24 inches	12 inches
38	contact	half an inch	normal	normal
7	2 inches	normal: no cerumen	24 inches	normal
14	2 inches	5 inches	24 inches	24 inches
29	2 inches	6 inches	normal	12 inches
40	4 inches	pressure	8 inches	5 inches
14	contact	normal: no cerumen	6 inches	normal
35	7 inches	half an inch	normal	normal

AGE.	HEARING DISTANCE BEFORE REMOVAL.		HEARING DISTANCE AFTER REMOVAL.	
	Right Ear.	*Left Ear.*	*Right Ear.*	*Left Ear.*
22	2 inches	contact	24 inches	normal
45	16 inches	3 inches	24 inches	8 inches
19	normal : no cerumen	contact	normal	normal
28	normal : no cerumen	pressure	normal	normal
—	normal : no cerumen	half an inch	normal	normal
46	quarter of an inch	pressure	half an inch	half an inch
23	4 inches	5 inches	normal	normal
44	pressure	pressure	normal	normal
25	normal : no cerumen	1 inch	normal	normal
14	2 inches	2 inches	normal	normal
60	1 inch	1 inch	9 inches	9 inches
27	normal	half an inch	normal	half an inch
50	18 inches	pressure	18 inches	24 inches
20	2 inches	4 inches	normal	normal
11	2 inches	half an inch	8 inches	8 inches
50	2 inches	normal	normal	normal
45	half an inch	half an inch	1 inch	1 inch
5	Crack of nails: no cerumen	2 inches	crack of nails	4 inches
35	10 inches	2 inches	normal	normal
28	1 inch	24 inches	24 inches	24 inches
41	normal : no cerumen	contact	normal	24 inches
14	12 in. : no cerumen	2 inches	12 inches	24 inches
24	pressure	pressure	normal	2 inches
60	1 inch	contact	1 inch	contact
34	normal : no cerumen	24 inches	normal	normal
19	2 inches	1 inch	24 inches	24 inches
61	2 inches	2 inches	3 inches	3 inches
65	crack of nails	crack of nails	crack of nails	crack of nails
24	contact	2 inches	normal	normal
40	normal : no cerumen	contact	normal	8 inches
60	contact	crack of nails	contact	crack of nails
56	quite deaf : no ceru.	contact	quite deaf	6 inches
21	normal : no cerumen	6 inches	normal	normal
40	6 in. : no cerumen	4 inches	6 inches	12 inches
51	normal : no cerumen	contact	normal	3 inches
50	6 inches	6 inches	normal	normal
55	crack of nails	contact : no cerumen	contact	contact
41	12 in. : no cerumen	contact	12 inches	5 inches
27	normal : no cerumen	half an inch	normal	4 inches
50	normal : no cerumen	contact	normal	1 inch
46	2 inches	half an inch	24 inches	6 inches
35	normal : no cerumen	pressure	normal	12 inches
45	3 inches	3 inches	3 inches	3 inches
74	crack of nails	2 inches	3 inches	6 inches
49	half an inch	half an inch	4 inches	4 inches
57	half an inch	2 inches	1 inch	3 inches
36	crack of nails	crack of nails	1 inch	1 inch
39	pressure	crack of nails	normal	normal
39	4 inches	contact	normal	14 inches
25	2 inches	normal : no cerumen	normal	normal
52	8 inches	1 inch	8 inches	2 inches
54	normal : no cerumen	contact	normal	6 inches
11	contact	contact	12 inches	12 inches

An analysis of the foregoing 100 cases shows the following to be the result of the examination of the 200 ears :—

Ears restored to a normal condition	60
Ears in which the hearing power was greatly improved .	43
Ears in which the hearing power was only slightly improved	35
Ears in which the hearing power was the same *after* as *before* the removal of the cerumen	27
Ears in which there was no wax, and in which the hearing power was normal, the opposite ear being affected .	24
Ears in which there was no wax; but in which the hearing power was not perfect, the opposite ear being affected .	11
	200

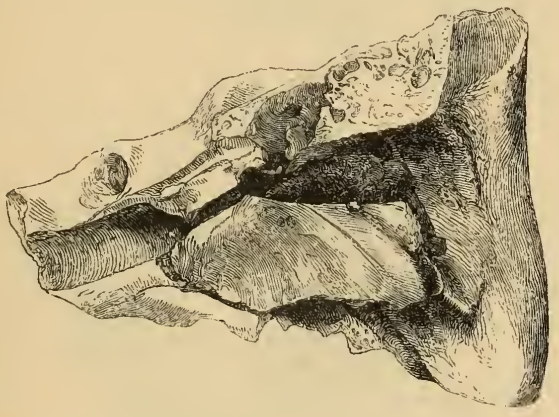
It thus appears that of the 165 ears from which cerumen was removed, only 60 were cured; that, including the 43 cases which were much improved, there were 103 cases of great amelioration, while there were 62 ears that were either but slightly or not at all improved. Thus, out of the 165 ears from which a collection of cerumen was removed, there were 105 in which there was some other disease, the restoration of the hearing not being perfect. The presence of cerumen in the external meatus may be symptomatic of several affections, as obstruction of the Eustachian tubes, or thickened condition of the tympanic mucous membrane, debility of the auditory nerve, anchylosis of the stapes, &c.; it is therefore important that every case should be carefully examined after a collection of this kind has been removed; because, if the hearing power be not wholly restored, some other disease is present which requires attention.

The causes producing accumulation of cerumen in cases not complicated with other diseases, are—a narrow calibre of the meatus; the application of cold; the admixture of dust with the cerumen; and, not unfrequently, the practice of pushing into the ear the point of a towel, whereby the cerumen is pressed into a mass towards the membrana tympani.

The symptoms of an accumulation of cerumen are—sudden deafness, often following a cold by which the dermis is tumefied; bathing or the introduction of water into the ear. This deafness is often better in the morning; is increased by the movements of the jaw during mastication; and often disappears

as suddenly as it came, with a cracking sound in the ear. The cause of the sudden appearance and disappearance of the deafness is the movement of the mass of cerumen: when it is so placed as to allow sonorous vibrations to pass between it and the wall of the meatus, the hearing returns; but when it again comes in contact with the meatus, the deafness recurs. Oftentimes a feeling of fulness in the ear is complained of; not unfrequently there is singing and giddiness, and sometimes considerable pain.

The symptoms of a collection of cerumen in the meatus vary according to the nature and position of the mass. Sometimes the whole of the meatus is distended by cerumen, the inner end of which lies in contact with the outer surface of the membrana tympani, of which it often forms a cast. In these cases, there is often giddiness arising from the pressure on the chain of ossicles. The symptoms of pressure on the brain are familiar to



CERUMEN IN CONTACT WITH THE OUTER SURFACE OF THE MEMBRANA TYMPANI

most surgeons; but it is not generally known that pressure on the contents of the labyrinth produces somewhat analogous symptoms. A mass of cerumen may force inwards the membrana tympani and the chain of bones, until the base of the stapes is pressed against the contents of the vestibule. In some cases of this nature, constant attacks of giddiness occur; in others, there is a confusion of ideas and an inability to walk straight; and in a third class, there is a feeling of weight and pressure on the head. These symptoms are often combated by the use of counter-irritants and depletion; but the only proper remedy for them is the removal of the accumulation.

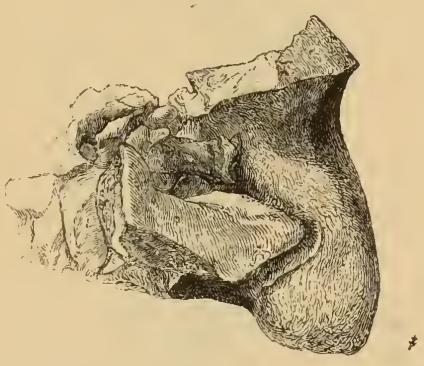
In certain cases there is a large mass in the outer half or two-thirds of the tubes, while the portion near the membrana tympani is empty; in others there is only a small quantity, which adheres to the outer surface of the membrana, and gives rise to great irritation, and irregular action of the tensor tympani muscle. When the mass is very hard, it is liable to cause inflammation of the dermoid meatus. A collection of cerumen may remain in the ear for many years, and the ears of the patient may have been frequently syringed without the nature of the affection being detected. Those accustomed to pay attention to cases of deafness will, however, generally be able to state when cerumen is present, even without any examination. I have frequently diagnosed the disease from the written account of a medical man; and a repetition of the syringing (which had previously been practised), but with increased vigour, has entirely removed the deafness. An examination with the speculum and a strong light should, however, always be made before adopting any treatment.

MEATUS GREATLY DILATED BY CERUMEN.

The prolonged presence of hardened cerumen in the external

ANTERIOR WALL OF THE OSSEOUS MEATUS PARTLY ABSORBED, FOLLOWING THE PRESSURE OF AN ACCUMULATION OF CERUMEN.

meatus is sometimes productive of injury to the walls of the meatus and to the membrana tympani. In my Museum are several specimens in which the osseous meatus has been much dilated; others in which the bone has been absorbed in parts; and in one instance a portion of wax was imbedded in the mastoid cells, having passed through an orifice in the attenuated posterior wall of the meatus. In another instance, where the cerumen, by its pressure, had caused an ulcerated orifice in the membrana tympani, a portion of it had found its way into the cavity of the tympanum.

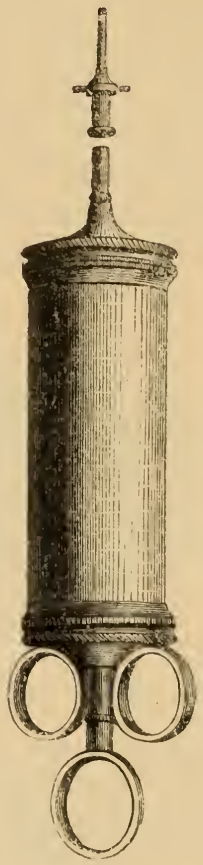


CERUMEN PROJECTING THROUGH THE MEMBRANA TYMPANI INTO THE TYMPANIC CAVITY.

The *treatment* of cases in which there is an accumulation of cerumen of course consists in its removal. The best, and indeed the only judicious mode of effecting this, is by the use of the syringe, which will thoroughly clear out even the hardest masses. The use of other instruments, as the scoop, has been suggested; but I have rarely known them to have been used without the production of pain, inflammation, and often of discharge from the dermis. No doubt the ordinary small syringe is not powerful enough to remove a hardened mass; but the one I usually employ, and which is valuable for many other purposes, holds three ounces and a half, and is furnished with two rings, so that it can be held in the right hand, and leave the left at liberty to hold the ear of the patient.

The nozzle of the syringe consists of a metallic tube of very small size, which should be made to take off until the water has been drawn in through the large aperture, and then be again fixed on. By doing this, air is kept out of the syringe and much time is saved, as it is not easy to fill a large-sized

syringe through a small aperture. The point of the nozzle should be somewhat larger than the body of an ordinary probe, so that the water may be injected with sufficient force, and



SYRINGE AND NOZZLE.

its return at the orifice be unimpeded. The ear of the patient should be brought opposite to a window, and the point of the syringe should be placed at the posterior part of the orifice of the meatus, or the stream is liable to strike against the anterior wall of the tube. Whenever the syringe is used, the ear should be drawn backwards so as to straighten the tube; and if this cannot be effected on account of the left hand of the surgeon being otherwise engaged, the posterior wall of the meatus may be pressed backwards by the point of the syringe. Warm water alone is generally sufficient, without the use of any solvent. It should be quite clear; and it is always desirable to have two vessels; one for the water before it is used, and the other to receive it when returning from the ear. If a glass vessel be used for the latter purpose, the condition of the water, and consequently of the ear, is more readily ascertained. The

use of an ear-spout is very serviceable during the process of syringing. It consists of a spring to pass over the head, at one end of which is a funnel to fit under the ear, down which the water can run into the basin.

EAR-SPOUT, FITTED ON THE HEAD.

In many cases, when the collection of wax is not very hard, the injection of one or two syringes full of warm water is sufficient to dislodge the mass; in others a much longer time is required, and when the wax has been very hard, I have sometimes injected warm water for twenty minutes or half an hour without removing any particles, or even causing the water to be clouded. At times it is well to let the wax become softened by the water before using the syringe again; and where the cerumen is unusually hard, or the meatus so tender that the syringing causes much pain, it is desirable to order a weak alkaline solution to be dropped into the ear in the intervals. As it is not desirable to proceed with the syringe when there is no wax left, the meatus should be frequently inspected to ascertain the progress made, as the deposit frequently comes away slowly in small pieces; the last portion, however, is usually large, and is often a cast of the membrana tympani. After the extraction of the cerumen, a piece of cotton wool may be worn for a day or two.

CASES OF ACCUMULATION OF CERUMEN IN THE MEATUS EXTERNUS.

Case I.—Mrs. R., aged 38, consulted me in July, 1854, on account of great dulness of hearing. She stated that, without any pre-

vious symptoms, ten months previously she had become suddenly deaf, first in one ear and then in the other. After being deaf for a month, there was a crack in each ear, and she regained her hearing, which had remained perfect until within a few days, when, during a severe cold, she again became deaf. Upon examination, I found the meatus of each ear full of dark cerumen; the hearing distance was only half an inch, and the patient required to be spoken to loudly within a yard. Upon removing the cerumen the hearing was perfectly restored.

Case II. *Mass of cerumen extremely hard and very difficult to remove.*—Lord D., aged between 50 and 60, consulted me, in April, 1851, on account of deafness in the right ear, accompanied by a sensation of fulness in that organ. A large mass of cerumen was detected in the meatus, which was not at all affected by syringing for half an hour. A solution of carbonate of soda in water (ʒj @ ℥j) was ordered to be dropped into the ear for some days; but the mass was scarcely at all softened. The application of the solution was therefore continued, and it was only after several weeks that the cerumen was dissolved sufficiently to be removed with ease.

Case III. *Accumulation of cerumen attended with pain and inflammation of the dermis.*—Miss H., aged 30, consulted me in May, 1853, on account of a shooting pain in the right ear, which she had experienced, with scarcely any intermission, during a fortnight. She was not aware that the hearing power was at all diminished. On examination, each meatus was found full of cerumen, the hearing distance of the right ear being half an inch; that of the left, ten inches. The cerumen was removed from each ear; and that in the right was exceedingly hard, requiring frequent syringing. The hearing distance of the right ear rose to six inches; that of the left became natural. The surface of the right meatus was red, and it was swollen. The pain ceased, and the symptoms of inflammation disappeared, after the cerumen was removed.

Case IV. *A mass of cerumen producing inflammation of the dermoid layer of the membrana tympani.*—J. R. M., aged 55, a surgeon, complained, in 1849, of pain in the right ear, with much deafness. The pain was paroxysmal; very acute; and was increased during the act of swallowing. The meatus was found distended with cerumen, the removal of which gave

immediate relief to both pain and deafness. The upper half of the dermoid layer of the membrana tympani, against which the mass of cerumen had evidently pressed, was red and much swollen; the lower half was healthy.

Case V. *An accumulation of cerumen causing neuralgic pains in the face.*—G. W. H., Esq., applied to me, in May, 1853, on account of a dulness of hearing in the right ear, accompanied by slight pain in the ear, and a good deal of pain over the right side of the face. This facial pain came on at times very suddenly, was very acute, and then disappeared: it had lasted for eight or nine days. A large accumulation of cerumen was found to fill the right ear: and when removed by the syringe, the dulness of hearing, the pain in the ear and in the face, entirely disappeared.

Case VI. *An accumulation of cerumen causing pulsation in the ear.*—W. E., Esq., aged 53, consulted me, in October, 1851, on account of a pulsation in the right ear whenever he reclines, but which ceases directly he assumes an upright position. He also complained of occasional singing in both ears. For these symptoms he had for some time been under medical treatment, but it had not succeeded in diminishing them. A mass of cerumen was found filling each ear, the removal of which improved the hearing greatly, and entirely removed the pulsation.

Case VII. *A collection of cerumen in the external meatus; giddiness and other symptoms of cerebral irritation cured at once by the use of the syringe.*—L. S. M., Esq., aged 43, consulted me in November, 1845. He stated that, five or six years previously, he had an attack of deafness in the left ear, attended with a considerable amount of singing noise; since that time he has occasionally felt deaf in a morning, but has usually recovered his hearing during the day, and at times, after blowing his nose, he has been deaf for a short time. Eleven months ago, after going into the open air from a warm room, a singing suddenly came on in the right ear, and has remained ever since. Lately he has had a sensation of weight at the top of the head, and frequent attacks of giddiness, which have caused him great alarm. While walking in the street, he has observed himself now and then to make "a lurch." Upon inspecting the ears, each meatus was found to be nearly full of hardened cerumen; which was carefully removed by means of the syringe. The

symptoms immediately disappeared, and he had no recurrence of them. Another patient, an artist, who suffered in the same way, was so giddy that he was obliged to lean on the railings, and rest, on his way to my house. He was also unable to discern the features of his "sitter" for more than a minute at a time, and had the greatest difficulty in writing an ordinary note. He likewise was cured at once by the removal of cerumen from each ear. A third patient was by the same means cured of a constant pain and numbness in the head: in a fourth, the pain had extended down the back. The following case is also interesting:—

Case VIII. *Confusion in the head, inability to walk straight, caused by a collection of cerumen.*—Mrs. R., aged 45, consulted me in April, 1845. She stated that, four months previously, she first began to experience noises in the ears, which were followed by a great amount of deafness. These symptoms lasted seven weeks, and then disappeared for three weeks, at the expiration of which time they came on again, accompanied by a sense of confusion in the head. This, at times, was so bad, that not unfrequently, for a few seconds, she could not tell where she was. She has at times been so giddy, that she has reeled and fallen in the streets; and, at other times, she has not been able to retain her hold of things, so that they have fallen from her hands. On examination, a large compact mass of cerumen was found in each ear; which, after some syringing, was got rid of; and the operation was followed by the entire disappearance of all the symptoms.

In some cases, the hard mass of cerumen has pressed against the outer surface of the membrana tympani, with sufficient force to cause inflammation of its substance, and of the mucous membrane of the tympanum. When this has been the case, the application of leeches has been required before the head symptoms entirely disappeared: in other instances, they have only gradually subsided, though, as a general rule, they disappear with the removal of the cerumen.

CHAPTER V.

THE EXTERNAL MEATUS (*continued*).

THE DERMIS AND ITS DISEASES.

1. ACUTE INFLAMMATION :—*a*, ACUTE INFLAMMATION CONFINED TO THE DERMIS—TREATMENT—CASES. *b*, ACUTE INFLAMMATION EXTENDING TO THE BRAIN AND ITS MEMBRANES—TREATMENT—CASES.
2. CHRONIC INFLAMMATION :—*a*, CHRONIC INFLAMMATION, WITH HYPERTROPHY AND ACCUMULATION OF EPIDERMIS—TREATMENT—CASES. *b*, CHRONIC CATARRHAL INFLAMMATION—TREATMENT—CASES. *c*, CHRONIC CATARRHAL INFLAMMATION, EXTENDING TO THE BONE AND TO THE BRAIN—TREATMENT—CASES. *d*, ULCERATION.

THE diseases to which the *dermis* of the external meatus is subject are :—

I. *Acute Inflammation,* ending in resolution, discharge of serum, mucus or pus, or in ulceration.

II. *Chronic Inflammation,* with or without discharge, polypoid growths, or caries of the bone.

I. ACUTE INFLAMMATION OF THE DERMIS.

This is one of the diseases hitherto comprised under the term *otitis.* The external meatus is very sensitive, especially towards the middle. This sensibility is due to the dermis, which is abundantly supplied with nerves and blood-vessels, and is covered by a delicate layer of epidermis. This membrane is liable to inflammation from many *causes,* such as the introduction of foreign bodies or acrid drops into the meatus; an accumulation of cerumen; the application of cold or of heat, especially when arising from sudden changes of temperature in the weather; or any debilitating illness.

The *symptoms* of this affection, at its commencement, are a feeling of fulness, stiffness, and uneasiness in the meatus, which is increased when the ear is pressed upon, or when the outer ear is moved by its muscles. This sensation is followed by

pain often very acute, although not so distressing as in severe inflammation of the mucous membrane of the tympanum: throbbing and singing often accompany the pain, and there is sometimes a diminution of the power of hearing. The latter symptoms are probably due to congestion of the middle and internal ears. With these symptoms there is generally a quick pulse, feverishness, and restlessness; and the pain sometimes extends over the side of the head. On *examination* in the early stages, the dermoid meatus is seen to be red, its blood-vessels being apparent through the epidermis. This redness sometimes extends to the dermoid layer of the membrana tympani, the vessels in the circumference of which become enlarged. Should the affection advance, the dermis becomes tumefied, so as to diminish the calibre of the meatus one-third or one-half, and the pain increases. In some cases, these symptoms subside without the formation of matter; in others, a copious secretion suddenly takes place, and is followed by such immediate relief that the patient thinks an abscess has burst. Examination, however, reveals the real condition of the meatus. The discharge filling the meatus having been carefully removed by the syringe, the surface of the tumefied meatus is seen to be of a deep red colour, wholly denuded of epidermis, and in its place secreting a mucous fluid. In the severe forms of this inflammatory action, this secretion consists of mucus, which comes away from the ear as a large mass of viscid white matter, somewhat analogous to that secreted by the mucous membrane of the tympanum in cases of catarrh; the difference being, that in the case of mucous from the tympanum, the circumference of the mass is more filamentous, the colour not so white, and the substance less consistent. After this discharge has continued for some days, it loses its viscidity, and becomes milky, remaining so as long as the affection continues to be chronic. When the inflammation is not very severe, the character of the secretion is always milky, not mucous. There are cases in which the secretion is thin, and nearly as transparent as serum; at times it is tinged with blood. The quantity of this serous secretion astonishes both patient and medical man. I have never had the opportunity of collecting the secretion, so as to be able to form a correct estimate of the quantity effused in twenty-four hours; but, judging from the saturation of handkerchiefs, linen, and pillows, it must amount to several ounces.

The source of this large quantity of secretion is the blood-vessels of the dermoid meatus, which are extremely numerous, and very large.

Some patients are subject to frequent attacks of acute inflammation of the meatus, but in them the symptoms are not very severe; in others, however, the inflammation extends to the bone, and thence to the membranes of the brain. It is not uncommon to see patients in whom there are some symptoms of cerebral irritation, though not of a serious character; while, in other instances, they are so formidable as to destroy life. These cases will hereafter be more fully described.

Acute inflammation of the dermoid meatus sometimes occurs from injury, but it usually subsides under the use of leeches and fomentations.

The *treatment* of acute inflammation of the dermoid meatus consists, in the milder cases, of the application of evaporating lotions, or of hot fomentations and poultices; in the more severe, leeches should be applied to the margin of the orifice of the meatus, so as to remove the blood directly from the congested vessels; and the meatus itself should be syringed with hot water, the head being slightly raised. The patient should be kept in bed, perfectly free from all noise, and small doses of opium may be administered. After the disappearance of the pain, the ear is to be washed out thoroughly with warm water, three or four times, or even oftener, daily; so as, in the first place, to ensure the removal of the whole of the discharge, which is apt to cause irritation, and, in the second place, to act as a warm bath to the inflamed membrane. Unless there is constitutional debility, or the ear has been weakened by previous disease, the discharge usually ceases in the course of a few days; the epidermis is again naturally secreted; and the power of hearing returns. Cases of acute inflammation of the dermis depending upon constitutional causes, and usually following nervous excitement, require to be treated by tonics in addition to the local applications. In some cases, however, foundation is laid for chronic catarrhal inflammation of the dermis, of which I shall presently speak.

CASES.

Case I. *Acute inflammation of the dermoid meatus, arising from cold.*—M. F., Esq., aged 26, a medical man, consulted me in

January, 1853, on account of great pain in each ear. He said that fourteen days previously, after being wet through, he had an attack of violent pain in both ears,—but especially in the left: after twenty-four hours' pain, discharge appeared and relief ensued. The day before consulting me, during a journey, pain was again felt in each ear, but more particularly in the right: at times the pain was greatly aggravated. On *examination*, the dermis of each meatus was seen to be very red and swollen; the epidermis was absent, but there was no discharge. The hearing distance of each ear was eighteen inches. An evaporating lotion was applied on cotton wool, and the affection subsided.

Case II. *Acute inflammation of the dermis. Copious secretion of mucus.*—Miss M., aged 17, tall, and rather delicate, consulted me, December 20, 1853, on account of pain in the right ear, accompanied with discharge.

History.—Ten days previously she felt a slight pain in the ear, which gradually increased so as to interfere with her rest at night. This continued for eight days, though better at times. Two days previous to seeing me, a discharge appeared from the ear, and has continued.

On *examination*, the meatus was seen to be filled with discharge, which, when removed by the syringe, was found to consist of a large white mass of mucus, about the size of an ordinary horse-bean, and of scales of epidermis. The membranous meatus was much tumefied, its surface being red; the dermoid layer of the membrana tympani was also red and swollen. The hearing distance was only eight inches.

Treatment.—Two leeches were applied to the orifice of the meatus, which was syringed out with warm water twice daily. The pain gradually subsided, and in six days the discharge had disappeared.

Case III. *Acute inflammation of the dermis; great deafness, and copious secretion of serum.*—A. H. H., Esq., aged 38, of a weakly constitution, sent for me in January, 1854.

History.—For three weeks he had been suffering from an attack of inflammation of the lungs, and four days previously, when becoming convalescent, was seized in the night with a violent pain in the left ear. This, in spite of treatment, lasted for about twelve hours, when a sudden burst of discharge took

place from the ear, which much diminished the pain. When seen by me on the fourth day after the discharge had appeared, there was still great sensitiveness of the meatus, and so great an amount of deafness, that the watch was not heard even when in contact with the ear. On *examination*, the dermis was found swollen and red, and the dermoid layer of the membrana tympani in the same state. So copious was the secretion of serum, that in half an hour a white handkerchief was perfectly saturated with it. Great fear was felt lest the ear should have been seriously injured by the inflammation; but finding that the membrana tympani stood out naturally, and feeling that congestion of the tympanic mucous membrane was quite sufficient to produce the deafness, hopes were held out that the hearing would return as soon as the congestion subsided. A leech was ordered to be applied to the margin of the orifice every second day: the meatus was syringed out with warm water twice daily, and slight vesication was used at the back of the ear. In the course of three days the discharge began to subside, the pain ceased, and at the end of ten days the hearing was restored.

Case IV. *Frequent attacks of inflammation of the dermis; hearing power natural.*—Miss C., aged 28, consulted me on March 7th, 1854.

History.—During two years has been subject to attacks of pain in each ear, followed by discharge, after which there has been an intolerable itching. Three months ago she suffered from one of these attacks of pain, since which she has had a constant irritation. On *examination*, the dermis lining each meatus was observed to be red and swollen. The hearing distance of each ear was natural. By applying leeches to the margin of the orifice of the meatus the irritating symptoms disappeared, and the recurrence of the attacks of inflammation was prevented.

ACUTE INFLAMMATION OF THE DERMOID MEATUS EXTENDING TO THE BRAIN.

Anatomical observations.—The blood-vessels ramifying through the membranous meatus are directly continuous with those entering and supplying the osseous meatus; the intimate connexion between the dermis of the meatus and the bone is therefore very obvious. The relations of the osseous walls of the external

meatus to the cavity of the cranium are deserving attention. In the adult it will be found that the upper wall of the meatus consists of a solid lamina of bone, varying from a line to two lines in thickness, which separates the cavity of the meatus from that occupied by the middle lobe of the cerebrum. In some cases a prolongation of the tympanic cavity is found extending into the substance of the upper wall of the meatus. In the child these relations differ remarkably from those just detailed. At birth, and for the first year subsequently, the only rudiment of the osseous external meatus is the superficial depression situated in the middle of the outer and lower part of the pars squamosa, immediately posterior to the root of the zygomatic process. This depression, to which the name "fossa auditoria" may be appropriately applied, has the rudiments of the mastoid process posterior to it; its surface is smoother, and its substance denser, it also contains fewer foramina for the transmission of blood-vessels, than the surrounding bone. At the period of birth, the portion of bone forming the fossa is not more than half or three quarters of a line thick, and the membranous meatus is attached to the outer, the dura mater of the middle cerebral cavity to the inner, surface. Its structure is far from being compact or dense, and in its substance the blood-vessels from the meatus communicate with those of the dura mater.

As the bone approaches maturity, the fossa assumes an oblique position, and forms the upper wall of the external auditory meatus, while it is separated from the cavity of the middle cerebral fossa by a dense layer of bone, into which cells communicating with the tympanic cavity are not unfrequently prolonged. In the adult the fossa auditoria has nearly lost its oblique direction, and become a horizontal lamina of bone.

From the foregoing remarks, it will be evident that disease of the membranous meatus externus is liable to extend to the outer surface of the bone, and thence to the interior. In the only case of fatal chronic disease which has fallen under my notice, the disease advanced posteriorly, to the lateral sinus.

Acute inflammation of the dermoid meatus may arise from the application of cold to the ear, or from the irritation of a foreign body: but neither cause is usually sufficient to produce extensive inflammation of the brain or its membranes, unless considerable constitutional irritation coexists.

For the particulars of the following case I am indebted to Dr. Nairne, who gave me the opportunity of dissecting the ear.

Case V. *Acute inflammation of the dermis of the external meatus, extending to the brain and its membranes, caused by picking the ear with a pin.*—Mary Wells, a single woman, aged 24, of a scrofulous family, was attacked on the 1st April, 1841, with severe pain in the right ear, which for some hours was distracting, and was followed by a sensation of something bursting, and by a discharge of blood and water, that afforded immediate relief. She had, prior to this, suffered no pain, and could only account for what happened from having picked her ear with a pin, to relieve a tingling in it. The discharge was mixed with blood for two days, and ceased entirely at the end of the week, when she felt pretty well. In a few days, however, she had a rigor, followed by violent pain in the ear, which lasted twenty-four hours, when a copious purulent discharge took place, giving relief as before. She was now free from pain, and felt in good health. The discharge continued profuse until the 24th of April, when it again ceased. The next day she was seized with violent pain in the right ear and side of the head, accompanied by vomiting and symptoms of general fever. As the bowels were confined, she was purged. On the 28th, the pain in the head returned with great severity, and towards evening extended towards the right ear, unaccompanied with pain or redness, or increase of pain on pressure. She vomited twice. Ever since the first attack, the hearing on the right side had been affected, and during the last few days she had complained of noise in the ear and giddiness, and carried her head bent backwards.* The pain increased, and on the 30th she was admitted into St. George's Hospital, and ordered a calomel pill and haustus sennæ.

On the 1st of May, her state was as follows :—Pulse 104, full, sharp, and compressible ; tongue red and glazed ; the skin hot and dry ; the conjunctiva slightly injected. There was slight intolerance of light, and a peculiar sensitiveness of the sense of touch, so that she shrank from the approach of a finger, though, when touched, she felt no pain. Her eyes were bright, and in constant motion ; the right pupil was a little more dilated than the left. The respiration was quick (thirty-two per

* Mr. Maule, who saw the patient two or three times, was of opinion that an abscess was forming in the internal ear.

minute). The countenance was placid, though the manner was rather hurried. The catamenia were present. She was cupped, had cold lotion applied to the head, and calomel and a black dose were administered. During the following night she was delirious, though the senses could be recovered by an effort.

May 2nd, 1 P.M.—There was a slight degree of opisthotonos this morning, and the nurse remarked that, on her getting out of bed, there was a peculiar rigidity of the muscles. She was, however, quite comfortable, and said that the headache went away about an hour after the cupping. Pulse 120, sharp but compressible; tongue red and glazed. She was ordered a blister behind the right ear, and three grains of hydrargyrum cum cretâ were administered night and morning.

3rd.—The feverish symptoms were somewhat abated, and she had some quiet sleep in the morning. The urine passed in natural quantity.

4th, 1 P.M.—Pulse again sharper, though the tongue was moist. The eyeballs were tender and suffused. No pain complained of, but she moans on being moved. The countenance is depressed, and she throws the clothes off her; she is, however, quite sensible when spoken to. Ice was ordered to be applied to the head. To proceed with other medicines.

3 P.M.—Is heavier and less sensible.

6 P.M.—The ice was applied about 4 o'clock, soon after which she went into a comatose state, occasionally, however, waving her hands, and appearing to recognise her friends.

5th, 11 A.M.—Became perfectly comatose about 4 A.M. She is now perspiring profusely. Pupil of right eye contracted. She died at 12.

Dissection of the body twenty-six hours after death. The weather warm. Head. — There were a few patches of lymph upon both hemispheres of the brain, immediately beneath the arachnoid, which was more vascular than natural. The convolutions of the brain were flattened and its substance was watery, but not soft, with the exception of the corpus callosum, fernix, and the parts contained in and near the lateral ventricles, which broke up easily on a slight touch. The cavities of the ventricles were large, and contained a quantity of turbid fluid. The pons Varolii, medulla oblongata, and adjacent nerves were smeared with concrete, purulent

lymph, effused into the cavity of the arachnoid. The cellular tissue around the optic nerves and their union, contained pus. The cerebellum was somewhat softer than natural. The dura mater covering the surface of the petrous bone was very vascular, and its vessels were distended with blood; it was also separated from the bone by a small quantity of serous fluid. The substance of the bone was of a dark colour, its blood-vessels being distended. On examining the internal ear, the membrana tympani was found to be entire, but both it and the mucous membrane lining the tympanic cavity were more vascular than natural. The chief disease was found in the external meatus, of which the membrane lining the inner third was soft, highly vascular, easily detached from the bone, and covered by purulent matter. There was no appearance of ulceration on the surface.

II. Chronic Inflammation of the Dermis lining the Meatus.

This affection may be divided into—

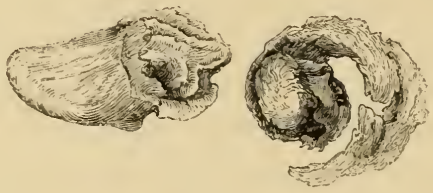
(*a.*) Simple Chronic Inflammation.

(*b.*) Chronic Catarrhal Inflammation.

(*a.*) Simple chronic inflammation.

This form of disease, without discharge, is frequently met with, and is often associated with a declining state of health, though it occasionally occurs as a purely local affection. One of the most common predisposing causes is residence in a moist atmosphere. In some very obstinate cases, change of air has been requisite before the affection could be abated. The exciting causes appear to be the same as those of acute inflammation, viz., the application of cold, or of any irritating substance to the meatus; perhaps the most common exciting cause is the habit of picking the ear with some foreign body. The symptoms of chronic inflammation are a feeling of distension in the ear, often coupled with slight pain, or with an intense itching. Sometimes the dermis is tumefied, so that the canal is diminished to one-half, or even to one-fourth of its natural size. In other cases, the dermis is scarcely at all swollen, but its free surface is red, and the epidermis is thrown off in large flakes. These flakes of epidermis accumulate and form large masses, which consist of several layers, and these masses are apt to block up the meatus, and produce a serious diminution of the hearing power.

Occasionally this epidermis collects in such large masses as to dilate the meatus, or to cause disease of the bone; in other instances, it produces acute inflammation of the dermoid meatus, and of the dermoid layer of the membrana tympani.



EPIDERMIS FROM THE EXTERNAL MEATUS IN THE FORM OF A TUBULAR CUL-DE-SAC, AND A LAYER ARRANGED CIRCULARLY.

Treatment.—When there is hypertrophy of the dermis, without much tenderness, a solution of nitrate of silver (ʒj @ ℥j) may be applied twice a week; and slight counter-irritation be kept up at the same time over the mastoid process. If the surface of the dermis is denuded of epidermis in parts, and more vascular than natural, the meatus should, in the first place, be syringed with warm water, in order to remove all the particles of epidermis which are apt to cause irritation, and at the same time soothe the dermis. While the syringing is being carried on, an astringent lotion may be applied, on cotton wool, to the surface of the meatus. After the inflammatory symptoms are subdued, a weak solution of nitrate of silver (gr. x. @ ʒj) may be applied twice daily. Should the epidermis continue to collect within the meatus, it must be removed by the syringe, which is generally sufficient for that purpose, notwithstanding that the removal of masses of epidermis, on account of its density, and the close way in which one layer folds within another, requires considerable patience.

CASES.

Case I. *Simple chronic inflammation of the dermoid meatus.*—R. P. A., Esq., aged 47, in good health, consulted me on July 4, 1853.

History.—During the last year and a half, he has suffered at times from extreme itching, with dulness of hearing, followed by slight discharge. Upon *examination*, the meatus of each ear, near the orifice, was found to contain a large quantity of soft

cerumen; at the middle part the dermis was of a deep red colour, and the blood-vessels were enlarged and tortuous. The hearing distance with the right ear was eighteen inches; with the left, seven.

Treatment.—Each meatus was washed out with half a pint of warm water, twice daily; and at night a lotion, consisting of a solution of chloride of zinc in water (gr. ij @ ℥j), was applied on cotton wool to each meatus. In the course of a fortnight he was quite cured.

Case II. *Simple chronic inflammation, with desquamation of the epidermis.*—Miss E. P., aged 39, in a somewhat debilitated state, consulted me on July 1, 1853.

History.—During the last two or three winters, after attacks of cold, has suffered a good deal of pain in each ear, accompanied by deafness. The pain remains for two or three days, then a skin comes away, followed by relief to the pain, and improvement in the hearing. Six months ago had a very bad attack, succeeded by discharge, which continued for a few days. During the last three years has suffered from considerable irritation in the ears. On *examination*, the meatus of each ear was found red in parts—a redness that, on the left side, extended to the dermoid layer of the membrana tympani. Portions of epidermis adhered to the surface of the dermis; and when these were removed, the dermis was quite denuded. The hearing distance of the right ear was three inches; of the left, one inch.

Treatment.—Two leeches were applied to the margin of the orifice of each meatus; warm water was syringed into each ear twice daily; and, when the congestion was diminished, a solution of nitrate of silver in water (gr. v. @ ℥j) was daily applied to both. A small portion of vesicating paper was also applied over each mastoid process, and tonic medicines were administered. This treatment afforded great relief; and when I saw the patient again in December, the hearing was very much improved, and there was an abundant secretion of cerumen in each ear. There had been one attack in the left ear in the month of August.

Case III. *Chronic inflammation of the dermis, with great hypertrophy.*—Miss T., aged 57, in tolerable health, consulted me in January, 1853, on account of great irritation and deafness in each ear.

History.—During the last five or six years has had attacks of deafness, accompanied by a considerable swelling in each ear. When the swelling decreased, the hearing power partially returned. About three week ago felt much irritation in both ears, accompanied, at times, by pain and much dulness of hearing, but not by discharge. On *examination,* each meatus was discovered to be so tumefied that the tube would only admit an ordinary sized probe; the surface of the dermis was of a plum colour: the watch was not heard, except when pressed on the ear.

Treatment.—Leeches were ordered to be applied to the orifice of each meatus, and to be followed by the use of a solution of nitrate of silver (℈ss @ ℥j). I did not hear the result.

Case IV. *Chronic inflammation of the dermoid meatus: accumulation of epidermis.*—The Rev. G. T., aged 55, consulted me in July, 1850, on account of pain in the left ear, with accompanying deafness.

History.—During several months has had a tenderness in the left ear, with a sensation of fulness, and a diminution of the hearing power: latterly these symptoms have increased. On *examination,* the surface of the outer half of the meatus was observed to be red, and somewhat tumefied, and the inner half was completely full of epidermis. Hearing distance with the watch, two inches.

Treatment.—The collection of epidermis was removed by the syringe and warm water. This operation, however, required the greatest care, on account of the extreme tenderness of the surface of the meatus; even the ordinary stream of water from the syringe being productive of great pain. After the removal of the collection, the hearing power was greatly improved. The surface of the dermis being red, a weak solution of nitrate of silver was applied to the surface of the meatus twice a week, which effected further improvements; but the epidermis again collected. After its removal, mild astringents were used, and the ear was syringed frequently with warm water, which diminished the inflammation, but the epidermis still continues to collect, and requires removal by the syringe every two or three months. The moist atmosphere in which this patient lives, is probably a cause of the unyielding character of the affection.

(*b.*) CHRONIC CATARRHAL INFLAMMATION OF THE DERMOID MEATUS.

This disease has been frequently classed among the cases of otorrhœa. As its name implies, it consists of chronic inflammation of the dermoid meatus, with accompanying discharge. In many instances the disease is confined to the meatus; but in others, it advances to the dermoid layer of the membrana tympani. It most commonly occurs in children; though by no means rare in adults. In childhood it is usually accompanied by a tendency to glandular enlargements or some other sign of constitutional debility. In the adult it is also too often symptomatic of a depressed state of health. *The exciting cause* may be an attack of acute inflammation of the dermis, an injury, the use of stimulating applications, or attacks of measles, scarlatina, or catarrh. Often this affection has no assignable cause, and appears with a slight itching in the ear; sometimes, indeed, the appearance of discharge is the first indication of diseased action. In the early stages, there is usually but little diminution of the power of hearing, even when the inflammation and hypertrophy extend to the dermoid layer of the membrana tympani. When the disease has remained for some time, the mucous membrane of the tympanum is apt to participate, and deafness to result. It must, however, be borne in mind, that catarrh of the dermoid meatus, and of the dermoid layer of the membrana tympani, are frequently symptomatic of irritation within the tympanic cavity, and that these exterior symptoms cease as soon as the internal irritation is overcome. In these cases of *sympathetic* catarrh of the dermoid meatus, there is usually a history of previous irritation in the tympanum, and much dulness of hearing commonly precedes the appearance of the discharge. After this affection has persisted some time, there is often a great degree of irritation in the meatus, sometimes there is pain, and now and then a discharge of blood. The latter symptom, however, is more common where a polypus is present.

On *examination* of cases of catarrh of the dermoid meatus, the dermis is generally found thicker than natural; sometimes so much so as nearly to close the tube. While in some cases the surface (denuded of epidermis) is red, in others it is blanched. The discharge has usually a very offensive odour; and its hue varies from milky white to dark slate colour. The peculiarity

of this discharge is, that whatever may be its quantity, colour, or consistence, there are no masses of mucus floating in it: but it mixes freely with water, producing a general opacity. In cases, however, in which a polypus co-exists with this form of inflammation, the discharge contains flocculent mucus, as also in cases of ulceration of the fibrous laminæ of the membrana tympani: sometimes there is also discharge of blood. When chronic catarrhal inflammation extends to the dermoid layer of the membrana tympani, the structure of this membrane, like that of the dermoid meatus, becomes hypertrophied, and often much congested; the membrane itself loses both its natural colour and form; its outer surface is flattened; while the processus longus, and frequently the processus brevis, are completely concealed by it.

The *treatment* of chronic catarrh of the dermoid meatus consists in the efficient and frequent use of the syringe and warm water, to thoroughly remove the discharge, and cleanse the tube. Should there be symptoms of pain or irritation, one or two leeches should be applied to the margin of the orifice of the meatus, and be followed by the use of warm fomentations, steam baths, or poultices. On the disappearance of the irritation, weak astringent injections may be used, and slight counter-irritation be kept up over the mastoid process. These measures, coupled with the administration of tonic medicines, and attention to the general health, will frequently put a stop to the affection. In more obstinate cases, it is requisite to keep up a discharge over the mastoid process by means of vesication or croton oil liniment: a solution of nitrate of silver (10 to 40 grains to the ounce) should also be applied to the surface of the meatus every third day. Some cases, in spite of all remedies, are but slightly ameliorated after two or three months' treatment; it is, notwithstanding, of great importance that the treatment be persevered in to prevent the supervention of caries of the bone, ulceration of the membrana tympani, and the development of polypus.

Case V. Chronic catarrhal inflammation of the dermoid meatus during teething.—J. A., aged nine months, pale and weakly, was admitted under my care at St. Mary's Hospital, in November, 1854, on account of an offensive discharge from the left ear.

History.—The mother stated, that about two months pre-

viously, when the child was irritable and restless from teething, a discharge took place from the left ear. Small at first, the quantity had gradually increased and become very offensive.

On *examination*, the left external meatus was seen to be full of a white milky discharge, that, when the ear was syringed, mixed with the water, which became opaque and milky, and masses of epidermis floated; but there was no appearance of mucus. After the discharge had been removed, the calibre of the tube was observed to be diminished one half by the swelling of the dermis, whose inner surface was denuded of epidermis and somewhat redder than natural: the dermoid layer of the membrana tympani was flat and white.

Treatment.—Daily exercise in the open air was ordered, and cod-liver oil administered. The surface of the body was to be sponged daily with tepid water, and the ear to be syringed out with warm water twice daily, and a solution of chloride of zinc (one grain to an ounce of water) to be applied on cotton to the tube of the ear during the night. The health of the child soon greatly improved, the quantity of discharge diminished, and, in six weeks, entirely ceased.

Case VI. *Catarrh of the dermis in both ears of a child, causing dulness of hearing.*—Master E. M., aged three years and a half, was brought to me on April 6, 1855, on account of a discharge from the ear, with dulness of hearing. He was pale and thin, his general health not good, and he was subject to enlargements of the cervical glands.

History.—About two years previously, without assignable cause, a discharge suddenly flowed from the right ear, and after another month the left ear was similarly affected; the discharge being abundant and the odour very offensive. After continuing for three or four months, the discharge disappeared from both ears; but about a month before consulting me, it had reappeared with the same symptoms as at first.

On *examination*, each meatus was found full of milky discharge, and red on the surface: the substance of the dermis swollen. The dermoid layer of the membrana tympani was red and thick. The hearing power was so diminished that he required to be loudly spoken to at the distance of two yards. The watch was unheard except when in contact with the right ear, or when pressed upon the left. It was evident that inflammation had

extended to the tympanic cavity as well as to the membrana tympani.

Treatment.—Both ears to be washed out with tepid water thrice daily, and afterwards to be syringed with a solution of acetate of zinc (five grains to the ounce); a portion of vesicating paper to be applied over each mastoid process every second night, and two tea-spoonfuls of steel wine to be given twice daily. This treatment in two months produced considerable benefit, the quantity of discharge diminished, and the power of hearing improved. This improvement, however, did not continue, and at the end of the year I saw him much in the same state as when first brought to me. I then found that the syringing had been very imperfect, a large quantity of discharge being left in the ears after the operation. Strict attention to this point was enjoined; a solution of nitrate of silver (gr. x. @ ℥ j) was applied to the surface of the dermis by means of a camel's hair pencil, night and morning; the vesicating paper was again used, and cod-liver oil prescribed. This treatment having been pursued for three months, the discharge had ceased, although the power of hearing was not wholly restored.

Case VII. *Chronic catarrhal inflammation of the dermis: great irritation.*—Mrs. A., aged 30, consulted me in August, 1856. She was in tolerable health.

History.—Two years previously she experienced at times great irritation and pain in the tube of each ear, followed by discharge: thinks the affection was caused by residence in a damp house; it was aggravated by exposure to cold air. Since the above period has had several similar attacks, and the ears are never quite free from itching and discharge. The power of hearing has not been diminished.

On *examination*, the surface of the dermis in both ears was found denuded of epidermis, red, slightly tumefied, and covered by a mucous discharge. Each membrana tympani was healthy. The hearing was natural.

Treatment.—As there was evidently much congestion, two leeches were applied to the margin of the orifice of each meatus, and both ears syringed with warm water twice daily. In the course of a week, the congestion having much diminished, a solution of nitrate of silver (gr. vj @ ℥ j) was applied to the

surface of each meatus by means of a camel's hair brush, twice daily. Under this treatment, and the occasional use of the syringe with warm water, the irritation subsided and the discharge disappeared. The affection, however, was slightly reproduced by a continuance of damp weather, or a reduction of the state of health; but speedily subsided under treatment.

Case VIII. *Chronic catarrh of the meatus externus after scarlet fever, accompanied by pains in the head.*—E. D., aged 7, was admitted under my care at St. George's and St. James's Dispensary on the 24th February, 1845. At three years old, he had an attack of scarlet fever, followed by ear-ache and discharge from each ear: after every attack of pain, discharge appeared. At present, and for the last two years, has complained of pain at the back of the head. On examination, the membranous meatus of each ear was found red, thicker than natural, and pouring out a milky secretion. Each membrana tympani was opaque, and its dermoid layer thick and vascular. The treatment consisted in the frequent use of the syringe and warm water, the application of a leech now and then to the margin of the orifice of the meatus, and tonic medicines. At the end of ten weeks under this plan the hearing greatly improved, and the symptoms of pain in the head disappeared.

(*c.*) CHRONIC CATARRHAL INFLAMMATION OF THE DERMOID MEATUS EXTENDING TO THE BRAIN.

It is not common for chronic catarrhal inflammation to extend to the bone and the brain; at least I have met with but one well marked case, in which death was the result.

Case IX. *Catarrhal inflammation of the dermoid layer of the external meatus, with caries of the posterior wall; disease extending to the lateral sinus and cerebellum.*—Harriet Baker, aged three years and a half, was admitted under my care at the St. George's and St. James's Dispensary, on the 6th December, 1848. Her mother stated that the child had always been sickly; and at five months old a thick creamy discharge had been seen to ooze from the left ear, which, though not abundant, was very offensive. The child had not till recently complained of pain, but now and then asked to have the ear picked, because of its itching. Three weeks ago the discharge ceased, violent pain ensued in the ear, with a swelling over the region of the mastoid and squamous processes, which caused the ear to project from the side of the

head: great restless and delirium followed, and she was constantly throwing herself about.

On *examination,* the surface of the dermis was red and denuded of epidermis; it was smooth but not ulcerated, and much thicker than natural, so that the cavity of the meatus was only one-third of its proper calibre. The membrana tympani was absent. The abscess behind the ear had opened; and about a wine-glassful of pus, of a most offensive odour, having been discharged, the surface of the squamous and mastoid processes was felt to be rough and carious. Linseed-meal poultices were applied.

Dec. 9th.—The discharge continues very copious; the pain and tumefaction have extended to the temporo-maxillary articulation, so that the jaw can be opened but a very little way.

14th.—The discharge, lately so abundant, has now ceased, while the pain and restlessness have greatly increased; the hands have been kept applied to the head.

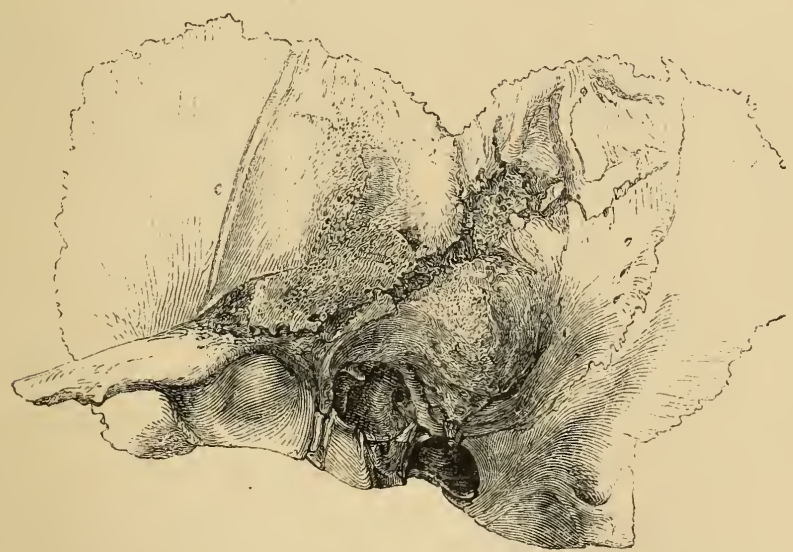
The head symptoms continued to increase till the 29th, when the patient died in a state of great emaciation.

THE INTERNAL SURFACE OF THE TEMPORAL BONE, SHOWING THE TWO ORIFICES IN THE LATERAL SINUS WHICH WERE FILLED BY THE CEREBELLUM, AND ALSO SHOWING THE CARIOUS SULCUS LATERALIS.

Post-mortem inspection.—On removing the calvarium, the dura mater appeared healthy, as well as the arachnoid and pia

mater. The lateral ventricles contained about half an ounce of perfectly clear serum. Upon the removal of the cerebrum there was no appearance of disease; the dura mater and arachnoid covering the upper part of the left petrous bone were quite healthy. When the tentorium was removed, the left hemisphere of the cerebellum was observed to be much softer than natural, and the portion in contact with the posterior surface of the pars petrosa was dark in colour and very soft. Upon gently drawing it backwards, it was found to be applied against two orifices in the posterior part of the lateral sinus, and to be separated from the cavity of the sinus by the thickened arachnoid and pia mater. A considerable vessel in the pia mater, opposite the orifice, was distended by a firm and dark coagulum, half an inch in length. The anterior membranous wall of the lateral sinus was absent; the bone forming the sulcus lateralis in the mastoid process was carious, and the sinus full of a dark-coloured coagulum and purulent matter; pus was also found in the jugular veins.

The ear.—The dermis lining the whole of the external meatus was soft, tumefied, and dark-coloured, and its surface was devoid of epidermis; beneath it, posteriorly, was purulent



THE EXTERNAL SURFACE OF THE TEMPORAL BONE, SHOWING THE CARIOUS PORTION EXTENDING FROM THE MASTOID PROCESS POSTERIORLY TO THE ROOT OF THE ZYGOMATIC PROCESS ANTERIORLY.

matter, which separated it from the carious bones. The membrana tympani was absent; but there was no more appearance

of disease in the tympanic cavity than might have been produced by the affection of the meatus. The bone was carious anteriorly as far as the root of the zygomatic process and the fossa for the articulation of the lower jaw; superiorly and posteriorly, the caries extended for the distance of an inch and a quarter, nearly to the margin of the parietal bone; but in some parts the external table only was affected, while in others it extended to the diploe and thence to the internal table. On holding the bone up to the light, small orifices were seen through it; so that its external surface, or that part which was covered by the membranous meatus, was directly continuous with the lateral sinus.

The progress of the disease in this case from without inwards, is very remarkable; for there is no evidence to prove that the disease originated elsewhere than in the meatus; and it is apparent, from the direct communication by blood-vessels between the membranous meatus and the bone forming the lateral sinus, that disease could easily be transferred from the inflamed meatus to the bone beneath. Careful consideration of the subject has, however, induced me to believe that the progress of disease from the meatus inwards, to the internal sinus and cerebellum, is of rare occurrence; and to think that the majority of the cases of this kind recorded as having occurred to previous inquirers, were really instances of disease advancing from the tympanic cavity or mastoid cells outwards, to the meatus, in which process the cerebellum and lateral sinus were implicated.

Treatment.—I have already stated it to be my opinion, founded on a consideration of some of the cases already adduced, that when a disease of the brain originates in a chronic affection of the ear, the cause of its prolongation to the brain may be traced to the want of a free egress for the matter.

The modes in which this matter may be confined are various. In the case of the external meatus, the tumefied walls, together with its peculiar valvular disposition as seen in infants, create a sufficient barrier to the free egress of the secretion. In the tympanic cavity, the matter is usually retained by the membrana tympani, which either wholly or partially prevents its escape; sometimes, however, the hypertrophy of the mucous membrane is itself sufficient to shut up the secretion in parts internal to it;

and occasionally even the thick accumulated matter itself may prove a bar to the egress of that which is beyond it. In the case of the mastoid cells, it appears that the matter may be retained by the peculiar position of their horizontal portion, the floor of which is often below that of the orifice into the tympanum; or it may occupy the vertical portion of the cells, which is quite below the part leading into the tympanum. The rules to be laid down in the treatment of chronic catarrh of the dermoid meatus, the mucous membrane of the tympanum, and the mastoid cells, are as follow :—

1. By attention to the general health to attempt to diminish the catarrh.

2. To secure, if possible, a free exit for the secreted matter.

3. By keeping up an external discharge, to cause that within the ear to be absorbed; and thus to arrest further secretion, and allay the diseased action.

General Treatment.—As far as general measures go, the same observations will apply to the diseases of each of the different parts of the ear. As it seems probable that the usual predisposing cause of these diseases is a scrofulous diathesis, every means should be taken to invigorate the health. Abundant exercise in the open air, especially in the country or by the seaside, simple, nutritious, but not stimulating diet, and mild tonic medicine, are to be specially recommended. Great care should be taken that the patient sleeps in a well-ventilated room, in a bed without curtains, the head being kept high and cool, and above the bedclothes. Everything which is liable to excite must be sedulously avoided; and rough play, in which the head is apt to receive a blow, must not be allowed. From whatever source the discharge comes, it is desirable, when practicable, that the membrane whence it issues should be washed frequently with tepid water; hence the use of the syringe is of great importance.*

* Many of the syringes in common use are very inefficient, as they do not send the water into the ear with sufficient force to remove the discharge. The best and most simple for patients to use, is the four ounce vulcanized india rubber bottle, made by Bell and Co. The metal nozzle should be made so as to allow of being easily removed. When the syringe is to be filled, the nozzle should be taken out, and the fluid to be injected should be poured into the bottle; or it may be allowed to fill itself, the air having been previously expelled by pressing the sides together.

When there is congestion, the application of one or two leeches is desirable, and sometimes gentle counter-irritation should be resorted to. This may be effected by a liniment to be rubbed over or around the ears and down the spine. Gentle astringents may also be used. Whatever may be the source of the discharge, as a general rule, its continuance for some months after the exciting cause is symptomatic of a scrofulous or otherwise unhealthy diathesis; and, in spite of every effort, the hypertrophied membrane is but very slowly affected, and consequently the discharge is generally of long duration. It is important, however, that the medical man, knowing the exact nature of the disease, and its peculiarly chronic character, should inform the parents or friends of the patient that any attempt to stop the discharge by powerful astringents, or otherwise than by gentle means, may be attended with serious consequences, as the production of acute inflammation. Here, perhaps, I may be excused a few words on a subject so frequently adverted to as the danger of stopping a discharge from the ear. The supposed danger of an arrest of the discharge by local applications seems to have originated in the knowledge of the fact, that one of the most common symptoms in the early stages of acute inflammation of the ear, following upon a chronic disease, is the cessation of the discharge which previously, and often for many years, had been constant. There can be no doubt that in these cases the cessation of the discharge is one of the effects, and not one of the causes of the inflammation; for other symptoms of inflammatory action may usually be observed before the discharge disappears. In cases where strong astringents have been employed in order to arrest a discharge from the ear, the symptoms that follow are not dependent upon the cessation of the discharge, (for, indeed, the discharge does not always diminish,) but upon the inflammation caused by the irritant.

To sum up what has been said respecting the general treatment, where there is simple chronic catarrh from the dermoid meatus, membrana tympani, or the tympanic mucous membrane, with free egress for the matter: when there are symptoms of congestion, apply one or two leeches near the part affected; syringe the ear frequently with an abundant supply of warm water; use mild astringent lotions, and endeavour to improve the health by every means possible to the patient. In face of

all these measures, the medical man may expect to see the disease make very slow progress towards amelioration; but he must be content that its advance inwards towards the bone and the brain is averted.

In cases of catarrh of the dermoid meatus there is very frequently some source of irritation of the tympanic mucous membrane, of which the catarrh of the meatus is but a symptom. Thus it is not uncommon to find obstruction of the Eustachian tube, even at the faucial orifice, attended by catarrhal inflammation, and even by polypus in the meatus; both of which secondary affections wholly disappear when the primary disease is removed. Cases of simple catarrh of the dermoid meatus do, however, occasionally occur: and one which terminated fatally has already been cited. As a general rule, they may be distinguished from the secondary cases by the absence of all appearance of disease in the tympanic cavity; by the power of hearing being but slightly affected, and by the healthy state of the membrana tympani, except an occasional increased vascularity of its dermoid layer. Primary catarrh from the dermoid layer usually occurs in children suffering from debility; when the dermis, instead of secreting its epidermis, pours forth a watery fluid composed of serum, in which float epidermoid cells in different stages of development. This discharge has often an extremely offensive odour, dependent generally, not upon the presence of dead bone, but upon a deranged action of the ceruminous glands. The discharge from the meatus, in cases of chronic catarrh, differs from that which attends the same affection in the tympanum in the way already pointed out; and it usually subsides under the use of a syringe and tepid water, tonic medicine, and the ordinary plans for strengthening the constitution of the patient. When the health is much deranged, it may take some months to effect a cure; but during the whole of this period daily syringing must be practised.

(*d.*) Ulceration of the dermoid meatus.

Cases of catarrh of the dermoid meatus, if neglected, may advance to ulceration; the bone may become diseased, and a small osseous lamina may eventually be discharged; but ulceration of the soft meatus usually arises from the pressure of dead bone from the mastoid cells making its way through the orifice of the meatus.

Besides the ulceration of the dermis, alluded to above, as resulting from disease of the bone, a second kind of ulceration, viz., having a syphilitic character, is also met with. Its local treatment does not differ from that pursued in other ulcerations of the dermoid structure.

CHAPTER VI.

THE EXTERNAL MEATUS (*continued*).

POLYPI.

CAUSES OF POLYPUS SYMPTOMS — THREE SPECIES OF POLYPUS :—1. THE CELLULAR RASPBERRY POLYPUS — STRUCTURE — TREATMENT WITH POTASSA CUM CALCE — CASES — TREATMENT BY REMOVAL WITH THE LEVER-RING FORCEPS — CASES. 2. THE FIBRO-GELATINOUS POLYPUS — STRUCTURE — TREATMENT — CASES. 3. THE GLOBULAR CELLULAR POLYPUS — STRUCTURE — TREATMENT — CASES.

Polypi.—Polypoid growths are not unfrequently met with in the meatus, and, as already stated, are generally the result of long-continued irritation of its dermoid layer; sometimes, however, they arise from chronic inflammation of the mucous membrane of the tympanum, or from obstruction of the Eustachian tube. As a rule, polypi are attached to the surface of the dermoid layer of the meatus, although I have met with cases in which they sprang from the outer surface of the membrana tympani, and in one dissection I found what appeared to be a polypus growing from the inner surface of the latter. The existence of a polypus is always attended with a discharge of matter; arising usually from two sources,—the dermoid layer of the meatus, and the surface of the polypus itself. In some cases there is a flow of blood, and generally a very offensive odour. A polypus, when small, usually causes little inconvenience, nor is its presence commonly detected, except by careful inspection;—when it grows large, however, a sensation of fulness is felt in the ear, and not unfrequently there is a sense of heaviness, giddiness, and confusion in the head. These latter symptoms are greatly increased when the polypus projects beyond the meatus, and happens to be pressed upon. Such pressure I have known to produce complete insensibility. Sometimes there is also a shooting pain extending from the ear to the

temple. These symptoms of cerebral irritation frequently cause great alarm to the patient and his friends, and appear to be the result of pressure of the polypus on the outer surface of the membrana tympani, and chain of ossicles, which causes a movement inwards, towards the cavity of the vestibule, of the inner extremity of the chain, producing continuous tension of the fluid of the vestibule. This is clearly shown by careful inspection of a specimen prepared by me for the purpose, by which it is manifest, that although there are two articulations between the long process of the malleus and the base of the stapes, yet the slightest movement inwards of the processus longus mallei causes the base of the stapes to be pressed inwards towards the cavity of the vestibule: and, as has been already stated, pressure on the contents of the vestibule appears to produce results very similar to those of pressure on the brain. According to my own observation, the former gives rise to—first, a sensation of noises; secondly, confusion of ideas; thirdly, giddiness and insensibility.

In all cases of discharge from the meatus, the first step is by the syringe to cleanse the tube. This done, there is no difficulty in determining whether a polypus be present, even though it should be situated close to the membrana tympani.

Polypi of the external meatus may be divided into three classes.

1. The one of most frequent occurrence, and which may be called the raspberry cellular polypus.
2. That which has been termed the fibro-gelatinous polypus.
3. The globular cellular polypus.

Each of these classes, and its treatment, will now be separately described.

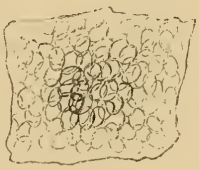
1. The Raspberry Cellular Polypus.

I have given this name to the polypus most frequently met

RASPBERRY CELLULAR POLYPUS.

with, which consists of numerous round beads, very similar in appearance to the free surface of the raspberry. These beads

are attached by small filaments to a central stem, which forms the root. Frequently it is covered by ciliated epithelium, and when examined microscopically, its interior is found to be com-



CELLULAR STRUCTURE OF THE RASPBERRY POLYPUS.

posed of small rounded cells. So soft is it usually, that upon being seized by the ordinary dressing forceps, it breaks up, and bleeds freely. This kind of polypus varies much in size; being sometimes not larger than a grain or two of mustard-seed, and at others so large as to fill the whole of the meatus, and project from the orifice. It is attached to various parts of the meatus, but generally to the inner half of the tube, and frequently close to the membrana tympani. When small, its colour is usually deep red; but as it grows, it becomes paler, and the rounded masses considerably increase in size.

A LARGE RASPBERRY POLYPUS, VISIBLE AT THE ORIFICE OF THE MEATUS.

The formation of these polypi is often attended with considerable pain, and by a discharge of blood: but it is not uncommon for them to remain undisturbed for several years, during the whole of the time throwing off a most offensive secretion, and yet not producing symptoms sufficiently urgent

to induce the patient to apply for relief; while in other cases, again, the head symptoms are so distressing as to cause serious alarm.

The *treatment* usually adopted consists either in applying astringent lotions and drops, or in endeavouring to remove the mass by instrumental means. As to astringent applications, there can be no doubt that they are usually ineffectual in preventing the growth of the polypus, in diminishing its vascularity, or in abating the quantity of secretion. The same remark applies to the use of nitrate of silver; for even under the influence of a strong solution of this substance, or of the solid nitrate of silver itself, I have seen the cellular polypus not only retain its vascularity, but rapidly increase in size. The two plans adopted by me for the removal of this kind of polypus, are the application of the potassa cum calce, and the use of the lever-ring forceps.

1st. *Of the use of the potassa cum calce.*—In the early part of 1852, a series of papers were published by me in the *Medical Times and Gazette*, advocating the use of the potassa cum calce; but since then I have suggested the use of the lever-ring forceps, the employment of which is so satisfactory that now I seldom resort to the former method. As, however, few medical men are likely to possess that instrument, and as the use of the potassa cum calce appears to be the next best plan for the removal of this excrescence, it is as well to give the result of my experience in that respect. In the first place, it is of consequence that the substance used should be made into very thin sticks. Those supplied to me by Mr. Squire, in the form recommended by Dr. H. Bennet, answer the purpose extremely well so long as they retain their size and form: but as this substance deliquesces very rapidly, the greatest care should be taken to exclude it from the air. For use at St. Mary's Hospital, the potassa cum calce has been manufactured by Bailey, of Wolverhampton, and recast into smaller sticks by Hopkins and Williams, of New Cavendish-street. This material contains a small quantity of iron, which makes it firmer and less deliquescent than that made in the usual way. The latter preparation, as not requiring so much care, may perhaps suit those better who are not often required to apply the remedy; though that which is free from iron is decidedly the most efficacious.

In applying the potassa cum calce, the first step is to syringe out the ear with warm water, and the next, to dry it with cotton wool. The patient should then be placed before a strong light, so that the surgeon, having a distinct view of the polypus, may take a stick of the caustic in the right hand, while he holds the ear back with the left; but the greatest care must be taken not to touch the surface of the meatus, which is so extremely sensitive that the pain produced by the action of an escharotic upon it is most acute. For the purpose of shielding the meatus, an oval glass tube may be used: it is to be passed down the meatus as far as the polypus, when, by gentle pressure, a portion of the excrescence may be made to enter the distal end of the tube. The polypus, unlike the meatus, has but little sensibility, and the potassa is to be pressed gently against it, the immediate effect of which is to decompose the whole of the substance to which it extends. If a pair of rectangular forceps be employed, neither the hand of the surgeon, nor the instrument he employs, will prevent the operator from seeing the polypus while he is making the application, and he can be sure that he touches the whole of the free surface. If this operation be carefully effected, the patient scarcely complains of pain; but if any portion of the escharotic happens to reach the surface of the tube, the acute pain it causes can be immediately arrested by syringing the ear with warm water, which should always be at hand. Supposing the potassa to have been thoroughly applied, the colour of the polypus at once changes from a bright red to a livid hue. After the operation, the patient should sit still for three or four minutes; and if the glass tube has been employed, it should be allowed to remain fixed as during the operation. Upon inspecting the polypus after three or four minutes, it will be found to be broken up, and blood to be oozing from it; while instead of its former rounded head, it presents an uneven pulpy mass. The meatus should next be syringed out with tepid water, when blood mixed with the débris of the polypus in a filamentous form comes away. The surface of the polypus still retains its dark colour, and, during several hours, a process of slow dissolution takes place in all that part which the escharotic has reached. If the cotton wool has rendered the polypus quite dry, it is desirable to moisten the potassa very slightly. As a general rule, the potassa may be again applied the following

day; and the process already described repeated, until the whole mass is destroyed.

Case I. *Vascular polypi near the membrana tympani; singing in the ear; power of hearing diminished; treated with potassa cum calce; cure.*—Mr. W. L., aged 40, was sent to me on the 20th July, 1850, by Mr. Cock, of Guy's Hospital. He was a large, strong man, and in good health. He stated that five or six months ago he found that he was dull of hearing in the left ear; this dulness was removed by the use of the syringe, which brought away a large quantity of cerumen. He remained without cause of complaint until three months ago, when the same symptom returned in the left ear. He was again in some measure relieved by syringing; but this operation was followed by a discharge of very offensive character, attended by a sensation of singing in the ear. He has at times complained of slight pain in the ear. On examination, the meatus was found to be full of matter, which, after being removed, was seen to consist of adhesive mucus mixed with epidermoid cells; the latter giving a milky aspect to the matter. The former presented numerous small flocculi, or rather little particles like cotton thread, from a line and a half to three lines in length. On re-examination of the meatus, after this mucous fluid had been withdrawn, a red-coloured polypus was seen, situated deep in the meatus, of which it apparently occupied the inner fourth, entirely obstructing the view of the membrana tympani. The power of hearing was much diminished, a watch not being heard except when pressed upon the outer ear. From the treatment of similar cases, I thought it undesirable to attempt a removal of this mass by instruments, not only on account of the soft nature of the polypus and its extreme sensitiveness, but also from the uncertainty as to the part to which the roots of the polypus were attached; I felt also that if it were fixed to the membrana tympani, the use of any force might be injurious to that organ. Having since ascertained by dissections * that the dermoid layer of the meatus is continuous with the dermoid lamina of the membrana tympani, it appears desirable on this account also not to use any force to a polypus attached to the vicinity of the membrana tympani,

* See, by the author, "On the Structure of the Membrana Tympani in the Human Ear."—Philos. Trans. Part I., 1851.

since a laceration of the meatus is likely to extend to the membrane.

July 21st.—The potassa cum calce was applied to the surface of the polypus in the way previously described; and in the course of a minute the whole of that part of the polypus which could be seen became of a livid hue, and, when the ear was syringed with tepid water five minutes afterwards, numerous small particles of the polypus, softened and disintegrated, were brought away. The patient complained of but very slight pain, which entirely disappeared on using the syringe.

29th.—The polypus is smaller and less red; the discharge from the meatus very copious. The potassa cum calce was again applied with similar results.

August 13th.—The polypus is observed to be much smaller. Instead of the mass which, at the first examination, had an appearance like a raspberry, there was now only a rounded button about a line and a half in diameter. The potassa cum calce repeated.

Oct. 18th.—The discharge is much diminished: its odour is less fetid; polypus nearly gone; and the power of hearing much improved.

Nov. 13th.—Since the last visit, a lotion, composed of a drachm of tannin to eight ounces of water, has been used twice daily. The discharge has now nearly disappeared, and consists almost entirely of epidermoid cells. The only vestige of the polypus consists in the presence of two very small buttons, each the size of a small pin's head; these are attached to the upper part of the membranous meatus, close to the membrana tympani.

29th.—The use of the injection has been continued; there is now no vestige of the polypus; the singing noise has ceased; but the surface of the membrana tympani is dull. Hearing distance of the watch, six inches.

The features of interest in this case appear to be: first, that although the escharotic was only applied at intervals of several weeks, the polypus did not increase in those intervals, but, on the contrary, gradually diminished; secondly, with the destruction of the polypus the singing also entirely disappeared; thirdly, the return of the power of hearing to so great an extent.

Case II. *Discharge from the left ear during many years; giddiness; polypus; treated by potassa cum calce; cure.*—The Rev. H. C., aged 40, consulted me on the 21st April, 1851. His constitution was not robust, as he had spent some time in India. The history of his case is, that the left ear has been deaf from childhood; that since early life he has been troubled with a discharge of offensive matter from that ear; and that lately he has complained of attacks of giddiness, especially upon suddenly rising from his chair. Upon examination, a red polypus was observed to fill the inner half of the meatus. The same treatment was adopted in this case as in the last, with the exception that, as the patient lived in the country, he had the potassa cum calce applied two or three times in the space of nine or ten days, and then a larger interval elapsed before it was again used. The same result, however, ensued; and at the end of six months the polypus had disappeared, and the symptoms of giddiness wholly vanished.

In another case, that of a patient aged 26, where the polypus filled the whole of the meatus, portions were removed by forceps and the remainder destroyed by potassa cum calce. The symptom of special interest in this case was the production of giddiness by pressure on the outer part of the polypus.

In cases of polypus which coexist with catarrhal inflammation of the dermoid meatus, it is desirable to keep a slight counter-irritation, by vesicating paper, over the mastoid process, while the polypus is being treated by the potassa cum calce. In order to remove the unpleasant odour of the discharge, an injection, composed of one part of the solution of chloride of lime to twelve parts of water, may be used three or four times daily.

2nd. *On the removal of the vascular polypus by the lever-ring forceps.*—Every surgeon who has attempted to remove a polypus, especially when situated near to the membrana tympani, must have found himself unsuccessful, if he has used the ordinary forceps. In the first place, it is almost impossible to lay hold of the growth, on account of the small size of the tube preventing him from separating the blades of the instrument; and should a large meatus enable him to do this, the instrument blocks up so much of the tube that he cannot see whether he lays hold of the polypus or not. Should the surgeon even succeed in seizing

the polypus, he will find that it breaks up and the roots are not touched.

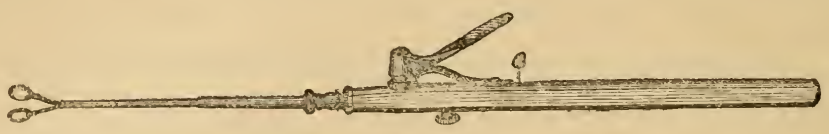
Various instruments have been invented, having for their object the removal of the small vascular polypi from the external auditory meatus. Of these, one of the best is the snare of Mr. Wilde, thus described at page 420 of that gentleman's work on "Aural Surgery:"—

"It consists of a fine steel stem, five inches long, and bent in the centre, with a moveable bar sliding on the square portion near the handle, which latter fits over the thumb. The upper extremity is perforated with holes running parallel with the stem, and loops at the angle serve the same purpose. A fine wire, fastened to the cross-bar, passes through these loops and holes; it should be of such length, that when the cross-bar is drawn up tight to the handle, the ligature is fully on the stretch. . . . In using it, the cross-bar is pushed forward, and a noose made of the wire at the small extremity, of sufficient size to include the morbid growth, which it is then made to surround, and towards the roots of which it is pressed by means of the stem; the cross-bar is then drawn up smartly to the handle, while the point of the stem is pressed downwards; and it never fails of either cutting across, or of drawing with it whatever was included in the noose."

The difficulty attendant upon the use of this instrument, consists in getting the wire noose around the polypus, which frequently is of very small size; another disadvantage is, that it cuts off a portion of the growth, instead of withdrawing it entire.

The instrument which I have been in the habit of using during several years at St. Mary's Hospital, as well as in private practice, with most satisfactory results, I have called the lever-ring forceps. In the interior of a tube is a delicate steel rod, the end of which is split into two portions, each having a small oval ring at its extremity, measuring four or five lines long, and from two to three broad. These rings (the inner surfaces of which are slightly serrated) are separated from each other when the lever is not pressed; but as soon as it is pressed, the rings are brought into contact. The instrument is introduced into the meatus with the rings apart, which having been made

to enclose the polypus, or a portion of it, between them, the lever is pressed down, the polypus seized, and instantly drawn out.



THE LEVER-RING FORCEPS OPEN.

Case III. *A cellular raspberry polypus in each ear removed by the lever-ring forceps; great improvement.*—M. I., aged 20, in good health, but having a tendency to glandular enlargements, consulted me on March 7th, 1853.

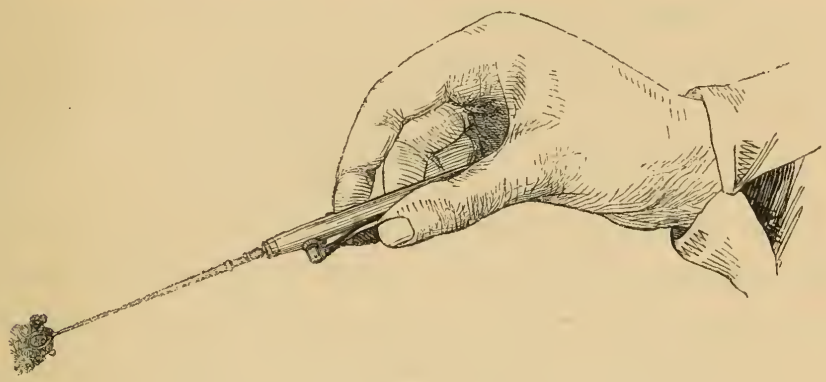
History.—When a child, suffered on several occasions from attacks of deafness, which lasted from ten days to three or four months, but by degrees disappeared. Between three and four years ago, the left ear began to discharge, and has continued to do so up to the present time. Within the last two months, the power of hearing in the left ear has so much decreased that he requires to be loudly spoken to close to it. A month ago, the right ear began to discharge, and is nearly as deaf as the left.

On *examination*, the watch was heard by the left ear when pressed against it; by the right when in contact. In each ear, near to the membrana tympani, was a large vascular polypus. When an attempt at a forcible expiration was made with closed nostrils, air passed freely out of the left meatus, but not through the right. The mucous membrane of the fauces was thick and red.

Previous treatment.—Excision of the tonsils, and the introduction of cotton wool into the bottom of the meatus. Neither operation was productive of benefit.

Treatment.—The polypus, by means of the lever-ring forceps, was first removed from the right ear. The patient stood upright, and reclined the head slightly towards the left shoulder. The gas lamp being held between the teeth, the patient's ear was drawn backwards by the left hand, so as to dilate and straighten the meatus as much as possible; a large-sized speculum was next introduced; and then, with the right hand, the lever-ring forceps was gradually pushed down to the polypus with the rings in contact. As soon as the rings reached the polypus they were allowed to separate, and when thus apart were made to surround the growth; when this was effected, the rings were brought into contact by pressing on the lever. The instrument was then

withdrawn, bringing with it the polypus, and leaving the membrana tympani exposed. During the whole of the operation I



THE LEVER-RING FORCEPS HOLDING A POLYPUS.

was able to see what I was doing, the rod of the instrument being so small as to occupy only a trifling portion of the tube. On the following day the hearing of the patient was much improved, the watch being heard at a distance of two inches; and the quantity of discharge had greatly diminished. The polypus in the left meatus was now attacked; but as only small portions of it came away at a time, three or four operations were required, which were followed by much improvement. A large aperture was detected in the membrana tympani, and, by the aid of the artificial membrane, the hearing power was still further improved.

Case IV. *Obstruction of the Eustachian tube at the faucial orifice; cellular polypus in the external meatus; removal; cure.*—H. W., Esq., aged 19, pupil to an architect, consulted me on February 19th, 1854, on account of deafness in both ears, and discharge from the right.

History.—From childhood has been subject to attacks of deafness during a cold; but they have disappeared after a duration of three or four weeks. About two years ago, he had an attack of deafness, which was followed by discharge from the right ear: this has lately increased, while the hearing power has considerably diminished. At the present time he has to be spoken to in a loud voice within the distance of a yard. On *examination,* the watch was heard only when in contact with the *right ear.* There was a large quantity of mucous discharge in the meatus, on removing which, a red polypus, with numerous projections from its surface, was seen to occupy the inner half of the tube. The Eustachian tube was impervious. *Left ear*—

hearing distance six inches; membrana tympani opaque and partly calcareous; the Eustachian tube impervious; and the mucous membrane of the fauces red and thick.

Treatment.—On the 25th February, by means of the lever-ring forceps, I removed a polypus as large as a horse-bean, which was attached to the posterior surface of the meatus, close to the membrana tympani. On the 1st March, the discharge had nearly vanished; and the membrana tympani was seen to be entire, though calcareous at parts. The hearing was much improved; the watch being heard at the distance of two inches. Tonic medicines were administered; the surface of the body to be sponged with vinegar and water; and an acid astringent gargle to be used thrice daily.

March 8th.—Hears much better. Two days before, after gargling, a sudden crack was felt in the right ear, after which he heard most acutely. Does not hear quite so well to-day, but still hears general conversation.

April 3rd.—The left ear has also much improved: can now hear perfectly.

March, 1855.—Have seen this patient recently, and he has remained quite well.

Case V. *Cellular polypus, causing deafness and serious cerebral symptoms; removal; cure.*—I. E., Esq., aged 21, was sent to me by Dr. Conolly on the 10th February, 1855, on account of deafness in the left ear, accompanied by occasional giddiness.

History.—Since six years of age has been subject to an offensive discharge from the left ear, with an occasional flow of blood: has not experienced pain, but has frequently had a sensation of fulness in the ear; and when the ear has been pressed upon, there has been considerable giddiness. Recently, symptoms of unnatural mental excitement have been experienced. On *examination*, it was found that the watch could not be heard, though the crack of the nails was distinguishable. On looking into the ear, a polypus was seen within half an inch of the orifice of the meatus, deep red in colour, and covered by a transparent discharge. Pressure at once produced a sensation of giddiness.

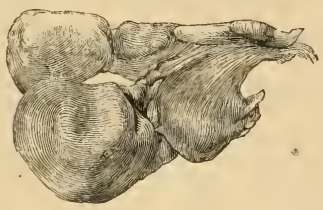
Treatment.—The polypus being of a large size, and somewhat firm, it was resolved to attempt its removal by the ring forceps: a considerable portion of the mass was thus extracted, but the

roots remained. Great relief at once followed the operation; and ultimately the lever-ring forceps succeeded in removing the rest of the morbid growth. The membrana tympani was found to be entire; the hearing was greatly improved, and the head symptoms wholly disappeared.

2. The Fibro-gelatinous Polypus.

Next in frequency of occurrence to the vascular is the one termed the gelatinous polypus. This name has been given to it from the soft, jelly-like appearance of its free portions, and from the similarity of its general aspect to the gelatinous nasal polypus. Careful and minute examination, aided by the microscope, does not, however, confirm the propriety of the designation, for, as will be seen presently, the term "*fibro-gelatinous* polypus" would be the more appropriate appellation.

Structure of gelatinous polypus.—This morbid growth generally attains to a large size. There are in my Museum specimens varying from the size of the last joint of the thumb to that of a small bean. Sometimes this polypus has a single root and body, but more usually two or more bodies have a common base. The root, which is attached to the wall of the meatus, is generally not larger than a line or two lines in diameter. Examining the polypus as it approaches the orifice of the meatus, near the root will be found attached numerous small rounded growths very like delicate granulations, which appear to be the rudimentary growths prevented from developing by the pressure exerted upon them by the walls of the meatus and the larger expanded part of the outer

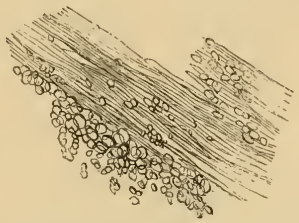


FIBRO-GELATINOUS POLYPUS; THE PEDICLE IS TO THE RIGHT, THE TWO ROUNDED MASSES PROJECTED FROM THE ORIFICE OF THE MEATUS.

portions of the growth. Approaching the orifice of the meatus the polypus assumes a globular form, consisting of from one to as many as six or eight rounded heads. When these heads are numerous, they have pedicles, varying in length from

a quarter to half an inch, and connecting them with the root. The surface of this polypus is smooth, and is constituted of a layer of about a quarter of a line thick, which may be separated from it by maceration, and which consists of cells bearing every resemblance to those of the epithelium covering the buccal mucous membrane. This epithelial layer is as thick and white as ordinary writing-paper; and when detached and floating about, it retains the shape of the polypus of which it had formed the surface. The interior of the gelatinous polypus is composed of corpuscles and fibrous tissue, varying in proportion in different specimens; but the fibrous tissue generally predominates. The corpuscles have a rounded form, but vary in size and shape. In a specimen which was a fair example of this kind of polypus as it comes under the notice of the surgeon, (it being white and soft, and readily compressible by the thumb and finger,) I found these cells varied in shape from a perfect round to an irregular oval,—and in size, from that of a blood corpuscle to a half or one quarter of its dimensions, the greater number appearing certainly smaller than the blood disc; but they presented every variety of size between that disc and a fine granule; and there was very little symmetry in form or size even between those which were nearest to each other. These cells are not generally in close contact, but are separated by a delicate gelatinous substance, which is sometimes quite transparent and structureless, and occasionally so abundant, as to form by far the largest portion of the mass. In parts where the polypus is resisting, these cells are separated by delicate wavy bands, having the appearance of fibres; and to the surface of these fibres the cells are observed to adhere. In some parts these wavy, gelatinous-looking fibres form almost the entire substance of the polypus, the rounded cells being scattered very sparingly: in others these fibres are absent. The wavy fibres run in the long diameter of the polypus, possess considerable toughness, and although easily separated from each other and isolated, they cannot be torn across without considerable force. In some instances these fibres are extremely firm, and the polypus is entirely composed of them, so as to become solid and very hard. When separated from each other, they wear the appearance of transparent lines, whose diameter varies from half to a quarter of

that of the blood disc. Interspersed through the substance of the polypus were many spindle-shaped crystals. On the application of acetic acid, the fibres became swollen and

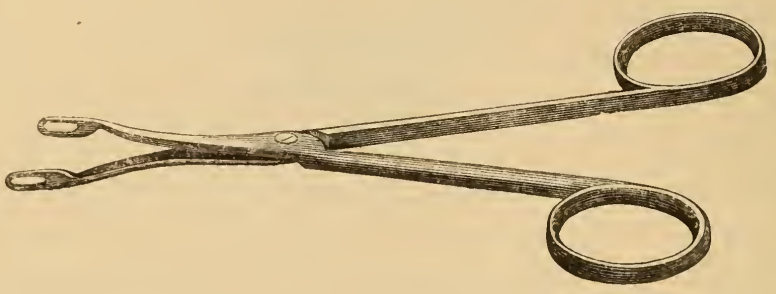


STRUCTURE OF THE FIBRO-GELATINOUS POLYPUS.

assumed a confused gelatinous appearance, losing all their fibrous character; the corpuscles were also converted into a similar mass; in which, however, a large number of granules were observable. The action of the acetic acid also brought into view a large addition to the number of fine spindle-shaped crystals previously seen. The gelatinous polypus sometimes attains to so great a degree of hardness that it is with difficulty cut through by a pair of scissors; a condition which appears to be produced by the increase in quantity and solidity of the fibrous tissue, the diminution of the quantity of corpuscles, and the absence of the gelatinous matter between them. It has been already stated that the vascular polypus is composed of rounded cells; which, however, differ very much from the cells of the gelatinous polypus, in being all of nearly the same size and shape, and larger than those previously described. The cells of this polypus do not appear to be separated by any substance, but they are agglomerated together and form the entire mass of the polypus. Its exterior also is smoother than that of the gelatinous kind, is always covered by its secretion, and is composed of a layer of epithelial cells which frequently terminate in ciliæ, that often continue in active motion for a long time after the removal of the portion of polypus which they cover.

Treatment of the gelatinous polypus.—The difference in the structure of the three kinds of aural polypi, naturally prepares the surgeon for a difference in their treatment. This is undoubtedly necessary. The use of the potassa cum calce, which has proved so efficacious in the destruction of the vascular polypus, is of but little service in the treat-

ment of the gelatinous, or, more properly speaking, the fibro-gelatinous polypus. The escharotic produces so trifling an effect upon fibrous tissue, that removal by extraction must always be resorted to. For this purpose, the best instrument is a pair of ring forceps, the ends of which should be reduced in size so as



THE RING FORCEPS.

not to be larger than from two to three lines in diameter. These forceps should be introduced into the meatus to the distance of half or three quarters of an inch, and the polypus seized as near as possible to its roots; the forceps should then be used as a lever, the outer part of the ear being the fulcrum, and the polypus turned out of the cavity. But little force is required; and, as a general rule, the diseased growth is extracted without difficulty in an entire state. In one case, that of the wife of a medical man, a large gelatinous polypus, which filled the greater part of the meatus, was removed by the frequent use of the syringe and warm water. The traction produced by the water in making its way outwards, seemed in the first place to diminish the supply of blood to the growth, which gradually darkened in colour, and was ultimately expelled. On examining the meatus after the removal of the polypus, the surface to which it was attached is distinctly discernible, and, for a short time, there is a slight oozing of blood from it. In some cases, portions of the root of the polypus remain; they do not, however, generally require any further treatment, but gradually wither and disappear. If, on the other hand, any of the small globular bodies remain attached to the root, they rapidly increase, and the diseased growth has again to be submitted to operation. The removal of the fibro-gelatinous polypus is generally productive of relief, not only to the unpleasant head symptoms caused by its pressure on the contents of the vestibule, but to the diminished power of hearing. The latter

improvement does not, as might be supposed, take place at once; on the contrary, it is not unusual for there to be at first no increase of hearing power, though it gradually and very slowly improves. This may, perhaps, be accounted for by the circumstance, that the polypus has for a long period exerted considerable pressure upon the membrana tympani, or, where that structure no longer exists, upon the tympanic ossicles; which organs only slowly return to their natural state.

Case VI. *Gelatinous polypus in the left ear for seven years—in the right ear for one year; noises in the right ear; giddiness upon pressure of the polypus. Cure by extraction, followed by the application of alum and chloride of zinc.*—Harriet Wenlock, aged 58, a washerwoman, strong, rather stout, and in good health, with the exception of the symptoms produced by the polypus, consulted me in the beginning of April, 1850. She stated that seven years previously, without any other symptoms, a discharge issued from the left ear, which has never disappeared; and shortly after the appearance of the discharge, a rounded body was visible at the orifice of the ear. About a year ago, the right ear also began to discharge, and there soon appeared a swelling at the outer orifice. She complains of great noises in the right ear; these vary much: sometimes they appear like a humming, at others like the tinkling of a bell,—then as if it were loudly ringing. When the surface of the tumour in the left ear is pressed upon, she feels giddy, and if it is continued, loses her consciousness, and falls. At present, and for a long time, she has been so hard of hearing, that she requires to be loudly addressed close to the head. On examination of the right ear, a round, pale-coloured polypus, more than half an inch in diameter, was seen protruding from the orifice of the meatus, below which was another growth about half the size. At the external meatus of the left ear a rounded body was observable, of not more than a line in diameter, and not extending beyond the orifice. Not finding any symptoms which indicated an affection of the bone, I thought it best at once to remove the polypi, and selected the right ear to begin upon. The diseased growth was removed with the greatest ease by the use of the ring dressing forceps in the manner before described: the patient suffered only a slight and momentary pain, and there was a very trifling oozing of blood. On examining it

after removal, the polypus was found to consist of the two rounded heads already noticed, each having a second mass, about half the size, continuous with it, and extending nearly as far as the root, which was very narrow, not being more than a line or a line and a half in diameter. The surface of the expanded part of this polypus was found to be covered with flat scabs, like those of epidermis; but nearer to the root, elongated cells, armed with ciliæ, were also distinguishable. The rounded parts, which were exposed to the air, were smoother and whiter than those which were concealed; the latter presenting a somewhat rugous surface. On April 22, a fortnight after, examination showed the quantity of the discharge to be greater than usual, and a rounded growth was perceived near to the membrana tympani, as if the roots of the polypus still remained; to this substance a solution composed of half a drachm of alum to two ounces of water was directed to be applied thrice daily. The polypus was removed from the left ear, and found to consist of a pedicle, a body, and three rounded heads, two of which had been visible at the orifice of the meatus during life.

April 20.—The power of hearing is improved. Has had slight pain in each ear, also some giddiness. The discharge, though less abundant, is still of an offensive odour. In the right ear the remnant of the polypus is seen attached to the upper part of the meatus near to the membrana tympani: in the posterior part of the latter an orifice was observed. In the left ear the roots of the polypus appeared to fill as much as one half of the meatus. The drops of the solution of alum to be continued.

May 6.—*Right ear.*—The discharge has ceased, the hearing has improved, and is much better after blowing the nose. The polypus has entirely disappeared, and the mucous membrane of the tympanum, which is thick and red, is seen through the orifice of the membrana tympani.

Left ear.—The roots of the polypus are much in the same state.

May 13.—The roots of the polypus remain as a week ago. Applied the chloride of zinc to their surface.

May 27.—Polypus of left ear smaller; again applied chloride of zinc.

June 24.—Discharge from left ear gone. The polypus much

diminished in size. Air passes through the left membrana tympani. The solution of alum was continued, and in a fortnight the polypus had wholly vanished.

Case VII. *Gelatinous polypus cured by extraction; hearing power improved.*—J. W., Esq., aged 24, a medical student, pale and not strong, consulted me on the 24th October, 1851, on account of so great a degree of hardness of hearing, that he was obliged to be spoken to at a distance not further than a foot from his head. He had also an abundant discharge from the left ear. The *history* of the case was, that twelve years ago he had an attack of porrigo, for which the head was shaved. During this attack he was very deaf in both ears, but quite recovered. A year ago, he became slowly dull of hearing in the right ear; and for eight months the left ear has been gradually losing its power of hearing. Has had pain in the left ear lately, with a discharge, which varies much in quantity, and has a very offensive odour. On examination, the hearing power of the right ear, tested by the watch, was only half an inch; the surface of the membrana tympani was dull, and its substance opaque.

Left ear.—Watch only heard when pressed upon the ear. A polypus filled the meatus and extended as far as the outer orifice: it was removed by the forceps, and the power of hearing slowly improved.

Case VIII. *Gelatinous polypus removed by forceps, and potassa cum calce applied to the roots; cure.*—Miss E. H., aged 26, consulted me on April 4, 1851, on account of a discharge from the right ear. The *history* of the case, as detailed to me, was, that at the age of sixteen, she had an attack of scarlet fever, with pain in both ears, especially in the right. The pain in the right ear was followed by a discharge, which has continued to the present time, with the exception of its once disappearing for a fortnight, when the pain greatly increased. On examination, a leaden-hued polypus was seen projecting from the orifice of the meatus, which was stated to have been seen there during the four months preceding the application for advice: pressure upon it had always produced giddiness. This polypus was found to be attached to the posterior and inferior part of the meatus, close to the membrana tympani. It was removed by the dressing forceps; and as the roots had a tendency to increase

in size, the potassa cum calce was applied once, and the growth was effectually destroyed.

Case IX. *Gelatinous polypus following bathing; removed by operation; cure.*—J. D., Esq., aged 36, consulted me, on May 20, 1853, on account of deafness in the right ear, with discharge. *History.*—Five years ago, after bathing in the sea, had pain in the left ear, followed by a discharge, that has continued ever since, and at times been very offensive. For the last two or three months this ear has become so deaf that he can scarcely hear at all with it. On *examination*, a large gelatinous polypus was found occupying the meatus nearly as far as the orifice. It was taken out by the ring forceps, and the hearing was immediately improved. An orifice was detected in the posterior part of the membrana tympani. The patient's hearing continued to improve; the watch was heard at a foot from the ear; and the discharge wholly disappeared. The roots of the polypus were found to have been attached to the surface of the meatus in the vicinity of the membrana tympani.

3. The Globular Cellular Polypus.

The third kind of polypus developed in the external meatus is the globular cellular species. I have thus named a growth which *essentially* differs from those belonging to the preceding classes. It consists of a single globular mass, perfectly smooth on the surface, and without any appearance of granulation. It is confined to the inner fourth or sixth of the meatus, from the

GLOBULAR CELLULAR POLYPUS.

upper part of which it is usually developed, and it hangs down like a curtain, wholly or partially concealing the membrana tympani. It is of a deep red colour, is softer than the ordinary cellular polypus, and does not generally attain a size larger than a small pea. This growth usually occurs in children or in young persons; it is attended by a mucous discharge, which is often very offensive; and the secretion, like that from

other forms of polypus, consists of epidermoid cells, which give a milky appearance to the water after syringing:—it also contains fine threads of mucus. This kind of polypus may exist for several years without producing any severe symptoms; and it has not hitherto been distinguished from the other varieties of polypus. It may be discriminated from the disease I have called chronic catarrhal inflammation of the dermoid meatus, by the discharge containing flocculi of mucus, like small particles of thread, and from its always presenting a red mass at the inner extremity of the meatus. This affection also differs from catarrhal inflammation of the meatus, in never terminating in disease of the bone; the discharge appearing to proceed from and be confined to the surface of the polypus only. The aural disease with which the globular cellular polypus is most likely to be confounded, is catarrhal inflammation of the mucous membrane of the tympanum: since, in some cases of the latter, the mucous membrane is of a deep red colour, and so much tumefied that it projects into the meatus for a line or a line and a half beyond the position occupied by the membrana tympani previous to its destruction. On examining the growth by means of the speculum and lamp, it is not always easy to determine which of the two diseases just described is present. The examination of the discharge, however, is sufficient to decide the question; for, although in both affections floccular mucus is present, that accompanying the polypus is composed of small thread-like particles, while that emanating from the mucous membrane of the tympanum presents large irregular-shaped masses, generally of a yellow colour. The history of the case will also usually aid the surgeon in forming a diagnosis, as the globular cellular polypus ordinarily appears without the manifestation of any very decided symptom; perhaps the appearance of the discharge is the first indication of its existence: whereas the affection of the tympanum generally originates in an attack of acute inflammation, and often arises during scarlet fever or measles.

Treatment.—The treatment of this kind of polypus is much more simple than that of the two species first described; nevertheless, except the true nature of the disease be ascertained, it is useless to employ the astringent applications commonly prescribed to arrest discharges from the ears. This affection stands

between the ordinary vascular polypus and catarrhal inflammation of the dermoid meatus; the former being wholly uninfluenced by the use of the strongest astringents, and the latter being generally curable by weak solutions of them: while the globular cellular polypus, though affected by astringent applications, requires them to be of considerable strength. The course of treatment followed by me, consists in syringing out the meatus of the affected ear with tepid water, to remove all discharge; and after the ear has been turned towards the shoulder of the side affected, to allow of the water running out, then to let three or four drops of an astringent solution fall into the meatus, and close the ear for half an hour by a portion of cotton wool, moistened with the solution. This course may be repeated twice, thrice, or oftener, during the day, care being taken that the sediment from the solution be removed before the drops are repeated. The preparations used by me are the acetate of lead, zinc, alum, or tannin; but the first-named has, I think, answered best. This species of polypus may often be removed in a week, or from that to a fortnight; and, to prevent any congestion in the tympanic cavity, a slight discharge from the surface of the mastoid process has generally been kept up during the employment of the astringent solution.

Case X. *Globular cellular polypus; discharge for three years; cured by the solution of liquor plumbi.*—Miss F. A., aged 12, of a rather weakly constitution, was brought to consult me on the 30th of March, 1850. Her mother stated that she had been dull of hearing during several years, in the left ear; and this dulness has of late so much increased, that when the right ear is pressed upon the pillow, she cannot hear even loud voices. During the last three years there has been a discharge from the ear, which has sometimes been very offensive, and at times, especially in the morning, it has been of a dark colour. There has been no complaint of pain in the ear; but a tenderness below it has been felt. At times there has been pain over the left eyebrow, extending occasionally to that side of the head. On examination, it was found that the watch was heard only in contact with the ear. By the aid of the speculum, a globular red growth, like a polypus, was discovered, concealing the membrana tympani, with the exception of a small semi-lunar

shaped portion at its inferior margin (about half a line in diameter at its centre), which was quite opaque. As this growth did not extend far into the meatus,—as it was of a deep red colour, and its surface quite smooth, it presented an appearance very analogous to that of the thickened mucous membrane of the tympanum; which, as has been stated, becomes sometimes so much hypertrophied, as to project into the meatus, and occupy a position nearer to the orifice than the membrana tympani did previous to its destruction. The presence of the latter membrane was in this case, however, ascertained; by the use of the otoscope, air was heard to enter the tympanic cavity without passing into the meatus; and the small portion of the membrana tympani which was visible, could be observed to be pressed out, and rendered tense and white, when the tympanic cavity was filled with air. It was clear, therefore, that the diseased growth was a polypus.

The *treatment* pursued consisted in applying to the surface of the polypus, thrice daily, a solution of the diacetate of lead; and, as I was not to have the opportunity of seeing the patient for two or three months, it appeared desirable that the solution should not be so strong as would otherwise have been advisable, so only six drops of liquor plumbi were added to an ounce of water.

June 18th.—The discharge has nearly disappeared, and examination shows the polypus to be reduced to the size of a large pin's head. The hearing was improved, the watch being heard at two inches instead of only when in contact.

I had no opportunity of seeing this patient again; but some little time after the last visit, I heard that the discharge had ceased, and the hearing so much improved that she was considered cured.

Case XI. *Globular polypus in right ear, broken up by forceps, and a solution of liquor plumbi applied; cure.*—Master A. H., aged 16, was first seen by me on the 13th of April, 1850. Both tonsils were enlarged; he had a tendency to glandular enlargements; and was at the time of his visit far from being in strong health. The *history* of the case was as follows:—At six years of age he had an attack of scarlet fever, which left him dull of hearing, a dulness that has increased during the last two years and a half; has had discharge of an offensive

character from the right ear during the last eighteen months.

Right ear.—On inspection, a polypus was observed at the inner extremity of the meatus, growing from its upper part, near to the membrana tympani. The polypus was red and globular, with a smooth shining surface. The discharge removed from the meatus was white like milk, not viscid; and it consisted of rounded cells similar to those excreted in catarrhal inflammation of the mucous membrane of the tympanum, and the nuclei of which were rendered very distinct by the addition of acetic acid. By aid of the otoscope, air is heard to enter the tympanic cavity; and in doing so, to produce a loud sound, like that attendant upon the sudden distension of a bladder by air. The watch was not heard over the ear, but only when pressed upon the temple.

Left ear.—The membrana tympani was dull on its surface, and white. Air passed into the tympanic cavity, producing a sound similar to that in the right ear. Hearing distance, a quarter of an inch.

April 17th.—By means of the rectangular forceps, the outer part of the polypus was broken up; it was very sensitive, and bled slightly. A solution of diacetate of lead in water (four grains to the ounce) was ordered to be dropped into the ear thrice daily, and a cantharidine cerate was applied to the nape of the neck.

25th.—The discharge much diminished, and its offensive odour has disappeared; the polypus is only one-third its former size, and the membrana tympani is seen beyond its lower border.

May 4th.—Much the same; prescribed a solution of chloride of zinc (ten grains to the ounce) to be dropped into the ear.

16th.—The discharge has disappeared; the hearing so greatly improved that the patient thinks he sometimes hears quite well; the roots of the polypus alone remain. The treatment was continued; and when I last saw the patient, on the 13th September, he was quite well.

In the following case, I adopted a more active plan of treatment. Being aware, from actual examination, that polypoid growths of the nature now under consideration are extremely soft, in order to remove them more rapidly I resolved

to apply an astringent to them of much greater strength than those previously used; and the complete success of this proceeding was very manifest.

Case XII. *Globular cellular polypus, destroyed by a strong solution of acetate of zinc.*—Miss T., aged 21, of fair complexion, and in good health, applied for advice on January 13th, 1852. The *history* of the affection is, that seventeen years ago, after an abscess behind the right ear, its hearing power greatly diminished, and has never returned. Six months ago, a discharge issued from this ear, which has continued without intermission to the present period. On examination of the right ear, the watch could be heard only when in contact, and the meatus contained a considerable quantity of discharge, consisting of tenacious thready particles of mucus, and mucous cells. At the inner extremity of the tube, a globular-shaped polypus, of a red colour, was discovered, attached to the upper part of the membranous meatus, close to the membrana tympani, which it wholly concealed, with the exception of a small semi-lunar shaped portion seen at its lower border.

Left ear.—Hearing distance, one inch. Membrana tympani white, like cartilage.

Treatment.—The right ear to be syringed out with tepid water thrice daily, and, after each operation, four minims of a solution of acetate of zinc (forty grains to the ounce) to be dropped into the ear. A small portion of vesicating paper to be kept over each mastoid process.

January 15th.—Slight pain was felt for half an hour after three applications of the drops; and yesterday the patient complained of a sensation as if the ears were distended. The discharge is diminished in quantity. The polypus had a greyish hue, bled in being touched, and appeared partially broken up. Large particles of the acetate of zinc had collected on the surface of the polypus.

19th.—Polypus smaller; no discharge; has had a good deal of ear-ache. To syringe with warm water, and omit the use of the drops.

22nd.—The pain is gone; there is no discharge; the polypus has wholly disappeared. The membrana tympani is now seen; its upper and posterior part is white and thick; at its anterior part, there are two small apertures, through which the mucous

membrane of the tympanum is seen to be red and thick; the hearing has improved: the watch is now heard by the right ear at a distance of three inches; by the left, at a distance of two inches. Subsequent reports from this patient state that the discharge has not returned, and that the hearing continues to improve.

CHAPTER VII.

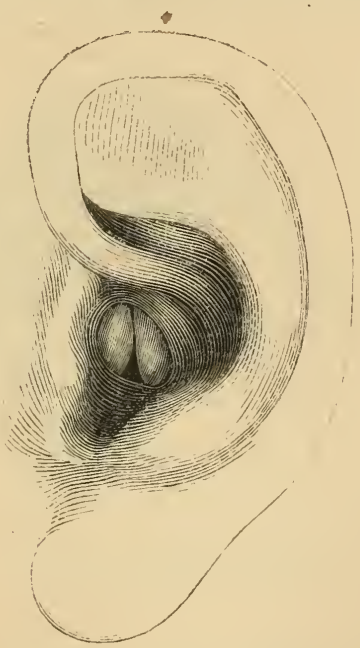
THE EXTERNAL MEATUS (*concluded*).

TUMOURS.

OSSEOUS TUMOURS—STRUCTURE—TWO CLASSES—TREATMENT—CASES—MOLLUSCOUS TUMOURS—STRUCTURE—EFFECTS ON THE BONE—TREATMENT—CASE—CONCLUSION OF THE SUBJECT OF THE DISEASES OF THE EXTERNAL MEATUS—TABULAR VIEW OF THE MORBID CONDITIONS FOUND IN THE MEATUS EXTERNUS IN 1013 DISSECTIONS.

I. Osseous Tumours.

However little it may have hitherto attracted the attention of the profession, there is reason to suppose that the growth of



TWO OSSEOUS TUMOURS PROJECTING FROM THE ANTERIOR AND POSTERIOR WALLS OF THE MEATUS EXTERNUS, LEAVING A SMALL TRIANGULAR APERTURE BELOW.

osseous tumours in the external meatus of the ear is a disease of no unfrequent occurrence. Such tumours appear to be the

result of a rheumatic or gouty diathesis, and may be developed in any portion of the length of the tube; but the part from which they most commonly originate is about the middle third of the passage. In one case, however, the tumour extended beyond the outer orifice of the osseous meatus, and could be felt by placing the little finger at the meatus. Occasionally the posterior wall affords the point of origin to the tumour, and then it not unfrequently resembles a simple bulging of the wall. In other cases, a similar tumour is also developed from the anterior part, and the two protuberances meet and lie in contact in the middle, leaving an inferior and superior triangular space in the place of the original opening of the tube. Sometimes the external surfaces of the tumours are in contact for nearly the entire length; and the only passage is a small orifice below. The tumour may also grow from the upper surface of the tube, and, by gradually increasing in size, almost or quite fill up the passage. Two or more tumours, again, extend sometimes from various parts of the circumference of the meatus, and, converging towards the centre, fill up nearly the whole cavity.

As far as my opportunities have permitted examination, these tumours, as in the one delineated below, appear to consist of

THE VERTICAL SECTION OF THE EXTERNAL MEATUS AND OSSEOUS TUMOUR, FROM WITHOUT INWARDS.

extremely hard and dense bone. In one case, where a portion of bone was denuded of membrane, it appeared shiny, white, and polished, like ivory. In another, where, under the misapprehension of the body being a polypus, caustic had been applied, the bone was exposed, and found to be extremely hard

and devoid of sensibility. In a third instance, where I observed the membrane to be absent, there was a thin layer of cartilage on the surface, beneath which the bone was very hard.

The tumours are usually covered by the lining membrane of the meatus, which is frequently thick, spongy, and less sensitive than is natural. When, by irritation, chronic inflammation is set up, this membrane pours forth a discharge whose odour is most offensive.

The development of these tumours is frequently unattended with any symptoms calculated to attract the attention of the patient; and therefore it is only when by their increase of size they act as an impediment to the passage of the sonorous vibrations to the membrana tympani, that the patient is inconvenienced by the deafness, and seeks relief. Deafness may result in these cases, first, from a collection of cerumen or epithelium lodging in and blocking up the small passage of the tube left unoccupied by the tumours; secondly, a drop of water may have entered the ear during the ordinary ablutions, and produced the same effect; thirdly, the growth of the tumour may have proceeded unchecked till the entire cavity of the meatus is filled up. In some cases, however, the growth of the tumours produces a feeling of distension in the ear, and weight in the affected side of the head; while in others, again, they appear symptomatic of, and consequent on, exostosis forming in the deeper regions of the ears; as, for instance, in the tympanic or vestibular cavities—a condition I have sometimes detected in the course of my dissections. In three instances, subsequently cited, there seemed great probability of this being the case; and the distressing noises and sense of giddiness may probably have depended upon the pressure exerted on the expansion of the auditory nerve by an exostosis in the vestibule.

The only diseased substance with which the tumours are likely to be confounded, are polypi; from which, however, by very slight attention, they may readily be discriminated. When inspected by means of the speculum, the polypus is seen to be darker in colour, and glistening, from being generally lubricated by discharge; the osseous tumour, on the other hand, is white; and though smooth, free from moisture. The base of the polypus is also generally narrow, while that of the osseous tumour is broad. Any doubt, however, is easily removed by the use of

the probe, which being pressed against the bony protuberance, at once reveals its nature.

The disease under consideration may be divided into two classes.

The first and most common is that in which the disease appears associated with congestion of the mucous membrane of the ear. Most of the patients who have consulted me on account of it were in the habit of partaking freely of stimulating food and beverages.

The second class showed symptoms indicative of disease in the cavities containing the expansion of the auditory nerve.

I will now proceed to point out some of the modes of treatment. In those cases where the tumours occupy a considerable space in the tube, and the deafness depends upon the occlusion of the canal by the accumulation of cerumen or epithelium, it is important at once to remove it, and prevent future accumulations. Where water penetrates into the orifice of the meatus, and fills up the only remaining pervious portion of the tube, wool should be placed in the orifice of the meatus when the patient is washing. Should the membrane covering the tumour, as is not infrequent, be very thick, a certain degree of relief may be afforded by the application of remedies which shall reduce its substance. In one case of this kind I was enabled to increase the size of the tube, and much improve the power of hearing, by applying a solution of nitrate of silver.

In order to diminish the size of the tumour itself, after the avoidance of a stimulating diet, the best remedy is that usually employed by surgeons in osseous growths, viz. iodine. This medicine I have prescribed internally, and have applied it behind the ear, and also to the surface of the tumours, with great advantage. In some cases large tumours were so much reduced as to allow of the passage of sonorous vibrations; and the patients regained in a measure that power of hearing of which they had for many months been deprived.

If further experience should establish the fact that these tumours can be arrested in their progress, especially at that early period when the area of the tube is but slightly encroached upon, much good may be accomplished and much suffering prevented or relieved. And while there are many weighty objections to any attempt to remove these tumours by operation or

by escharotics, there are none to the use of iodine and the other absorbent medicines, from which there is every prospect, by persevering use, of successful results.

In consulting authorities on this interesting subject, the only observations I have met with in Kramer are the following :—

"They (polypi) are even of cartilaginous and bony hardness.

"A stalactite-shaped growth hung from the superior surface of the meatus, very near the membrana tympani, and was of so remarkable a bony hardness and density, that it was impossible to pierce it even with the sharpest knife." *

Itard, although he states that the principal causes of the diminution of the external auditory meatus are the enlargement of the osseous, cartilaginous, and membranous structures forming the meatus, says :—

"I have never had an opportunity of observing the enlargement (*gonflement*) of the osseous part of the external meatus, and the extreme hardness which it possesses would tend to make this kind of alteration very rare." †

Case I. *Tumours in each ear, with deafness; tumours diminished in size; deafness cured.*—June, 1848: D. N., aged 65, for the last few weeks has been feeling somewhat deaf, especially in the left ear. This deafness is increased by an attack of cold, to which the patient is subject.

Right ear.—Meatus partly filled with bony growths; one rising from the anterior, the other from the posterior part of the meatus. Membrana tympani dull. Hearing distance less than that of a healthy ear.

Left ear.—Meatus blocked up, except a small orifice, by three tumours which project from the walls of the meatus. The space left between these bony growths was occupied by a collection of cerumen, which being removed, the power of hearing, though still deficient, was to a certain extent improved.

Considering that every attack of cold increased the deafness, and that the membrana tympani was dull,—a thickened state of the mucous membrane seemed also indicated,—the following course of treatment was adopted. Alterative doses of blue pill

* On the Nature and Treatment of Diseases of the Ear. Longman. 1847. P. 117.

† Traité des Maladies de l'Oreille et de l'Audition. 1821. Tome i. p. 328.

were administered, and the surface of the meatus was washed with a solution of argenti nitras, one drachm to the ounce, every

THREE OSSEOUS TUMOURS PROJECTING FROM THE WALLS OF THE MEATUS.

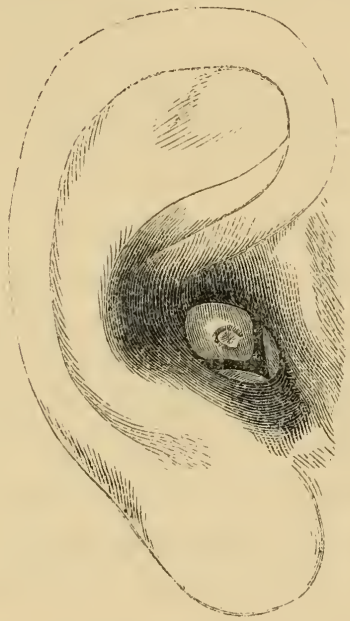
fourth or fifth, and afterwards every seventh day. This course of treatment was continued for three or four weeks, and the power of hearing was largely extended. The plan was resumed the following year, and the ultimate result was a perceptible diminution of the tumour, arising, as I believe, from a decrease in the thickness of the investing membrane; and the power of hearing was completely restored.

Case II. *Tumours in both ears; deafness produced by the presence of a drop of water in the meatus.*—July, 1846: E. F., aged 60, has been so deaf in the right ear, for some years, as to derive little use from it. Has several times lately become suddenly so deaf in the left ear as scarcely to be able to hear a conversation. These attacks have usually come on in the morning after washing, and frequently lasted for some hours.

Right ear.—Two bony tumours were observed in the meatus, occupying about one half of its calibre. Membrana tympani dull.

Left ear, meatus.—Extending from the upper part of the meatus is a long bony tumour, taking up two-thirds its calibre. This tumour is covered by a thick soft membrane, excepting at one point of about half a line in length, and a quarter of a line

in breadth. From the anterior and posterior parts of the lower half of the tube projected two small elevations of bone, about three quarters of a line in thickness, in the direction of the larger tumour, so as to leave but a very small triangular space between them. This space was the only opening by which the



A LARGE OSSEOUS TUMOUR AND TWO SMALLER ONES IN THE MEATUS EXTERNUS.

sonorous undulations could pass to the membrana tympani; and it was found that, during the operation of washing, it was liable to be filled up by water, which produced temporary deafness. The opportunity of carrying out a course of treatment for the diminution of the tumours was not given to me; but by adopting means to prevent the entrance of water into the meatus, the attacks of deafness were entirely prevented.

Case III. *Tumour in the meatus of the right ear. Orifice in membrana tympani of left ear.*—Nov. 13, 1845: P. H., aged 56, eleven years before, when in Russia, fell asleep in a garden. The next day felt severe pain in the left ear, which lasted during fourteen days, when matter began to discharge. Has had several attacks of pain in the left ear since that period, which have been accompanied by beating and singing.

About six months ago, being then in the West Indies, had an attack in the right ear, followed by a diminution of the power of hearing, but there was no discharge. Two months

ago he returned to England, and entirely recovered the use of the right ear, hearing better also with the left. Within the last four days pain came on in the left ear and rapidly increased, followed by pain in the right ear, and so great an extent of deafness in both ears as to require him to be shouted to.

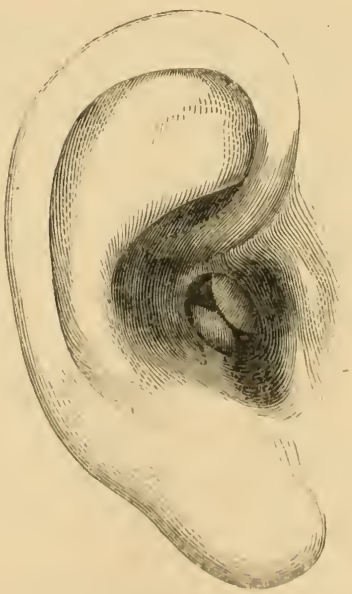
Right ear, meatus externus.—The middle two-thirds of the lower wall are occupied with a bony tumour filling half the calibre of the tube.

Left ear.—Meatus externus red, and covered by discharge. Membrana tympani white, soft, and thick, with a small orifice, through which air passes.

Case IV. *Osseous tumours in each ear ; feeling of confusion in the head.*—Nov. 4, 1848: T. T., aged 38. Last year deafness gradually came on in the left ear, with occasional attacks of deafness in the night. This deafness has of late very much increased, and been also attended with a feeling of confusion, and a sense of oppression in the head.

Right ear.—Projecting from the whole of the anterior and posterior surfaces of the external meatus, are two osseous growths, which come into contact in the centre of the tube. Hearing distance one foot.

Left ear.—Two similar tumours likewise exist in the meatus



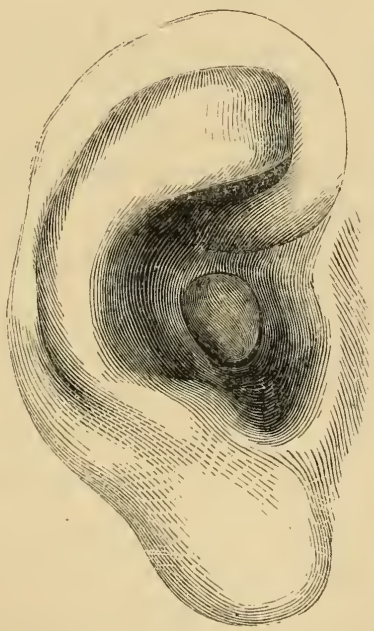
TWO OSSEOUS TUMOURS OF THE EXTERNAL MEATUS IN CONTACT INTERNALLY.

of this ear ; but at the superior part they have so increased as to be in contact throughout, save a small orifice at the lower

part. The deafness in this ear had been greatly increased by the presence of a small quantity of cerumen, which had filled up the small orifice just described; and its removal gave temporary relief; but it was evident that the tumours would go on increasing until the entire passage of the meatus was blocked, unless remedial measures were at once adopted. For these no opportunity was afforded me.

Case V. *Large tumour in left ear, causing deafness; diminished by the use of iodine.*—Feb. 1849: S. P., aged 17, states that deafness commenced in the left ear, about two years and a half ago, and has been gradually progressing, till at length he cannot hear at all with that ear. Sometimes there is a violent itching, followed by discharge, and the tube of the ear is so sensitive, that the least touch causes exquisite pain. There is also a continuously unpleasant sensation, as if the ear were being distended. He complains of dulness of hearing in the right ear. Has been to various surgeons and public institutions, but without obtaining any relief.

Right ear.—A large osseous tumour occupies nearly the whole of the meatus, and is attached to its upper part. It is



AN OSSEOUS TUMOUR GROWING FROM THE UPPER WALL OF THE MEATUS, AND OCCUPYING NEARLY THE WHOLE OF ITS CALIBRE.

covered by the dermoid lining of the meatus, which is about a third of a line thick.

Left ear.—Healthy.

Tincture of iodine was applied to the surface of the tumour, as also behind the ear, and four grains of iodide of potassium were given thrice daily for between two and three months. Great relief was the result; the size of the tumour diminished; the power of hearing greatly increased; the tube of the ear lost its unnatural sensibility; and the unpleasant sensation of distension completely vanished.

Case VI. *A tumour in the right ear, filling nearly the entire tube; slight protuberances in the left ear.*—Nov. 25, 1848: J. S., aged 65, states that ten years ago he had a gathering in the right ear, with great pain and much discharge. Continued, however, to hear pretty well until within about a month previous to applying to me, during which he has grown so very deaf that he cannot hear, unless the speaker's mouth approaches close to the ear.

Right ear.—The external meatus contained a collection of epithelium, on the removal of which an osseous tumour was disclosed, filling nearly the whole of the tube. The tumour projected from the upper and lateral surfaces, and nearly touched the lower wall of the tube. Watch not heard in contact with the ear.

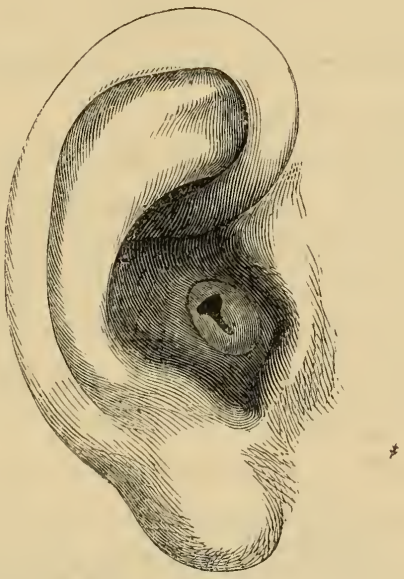
Left ear.—The lower wall of the meatus presents two slight and quite hard elevations.

Treatment.—Alterative doses of blue pill were prescribed, and tincture of iodine was directed to be applied behind the ears. The result I have not heard.

Case VII. *Tumour in the right ear following the extraction of a polypus.*—June, 1847: Rev. J. D., aged 47, consulted me for a continued discharge from the right ear. He stated that twenty years previously, after the forcible removal of a collection of wax from the right ear, he experienced great pain, followed by an offensive discharge, that had lasted to the present time. On examination, a large, red, and firm polypus was perceived to fill the whole of the meatus, nearly as far as the orifice. It was attached to the wall of the meatus, near to the membrana tympani, and on its removal the latter was found to be very thick and vascular, with a small orifice at its lower part. The discharge wholly disappeared.

In July, 1857, the patient again consulted me on account of a slight return of the discharge, accompanied by some degree

of pain in the right side of the head, with an unpleasant sensation of fulness and pressure in the ear. On inspection, the meatus was found contracted to one-fourth its natural size by the growth of osseous matter from its walls, especially anteriorly and posteriorly, thus leaving a mere triangular opening, through which only the central part of the membrana tympani was visible, and that was white and thick.



OSSEOUS MATTER DEVELOPED FROM THE WALLS OF THE MEATUS EXTERNUS, LEAVING A TRIANGULAR SPACE IN THE CENTRE.

I recommended the use of a strong solution of liquor plumbi to stop the discharge from the tube, and the application of the tincture of iodine behind the ear.

In this case there had been long standing disease of the tympanic cavity, membrana tympani, and meatus, consequent on local injury. The disease was attended with so great an amount of deafness, that it appeared as if the cavities containing the expansion of the auditory nerve might also be implicated.

Case VIII. *A protuberance of the lower wall of the meatus in the left ear.*—December, 1848: L. E. H., aged 25, ten years previously experienced a singing in the left ear, which during a cold became much worse, and was attended with a feeling of numbness. A cold has lately aggravated all the symptoms in the left ear, and called forth a noise like a bell in the right ear.

Right ear.—Membrana tympani dull; hearing distance two feet.

Left ear.—Meatus contained a large quantity of cerumen, after the removal of which the passage was observed to be red. At the lower wall near the membrana tympani there is a considerable bulging of the osseous wall. Hearing distance half an inch.

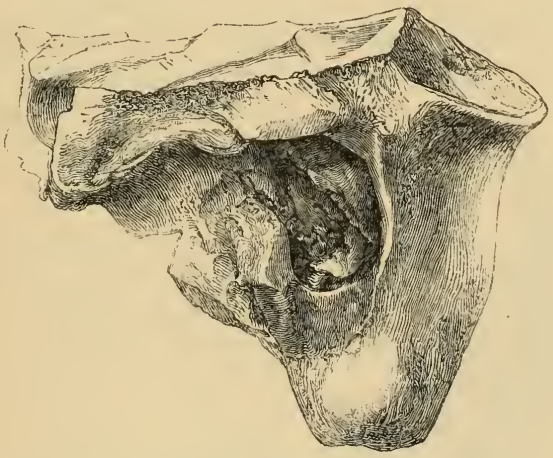
In this case the diminished degree of hearing in the left ear did not depend upon the enlargement of the external meatus, for there was no doubt of a thickening of the mucous membrane lining the tympanic cavity.

Case IX. *Osseous tumour in the external meatus, causing a collection of epidermis and serious cerebral symptoms; relieved.*—J. J. S., Esq., aged 56, consulted me on the 27th April, 1850. He stated that when a boy he had a discharge from the right ear, since which period he has been deaf at times, and been subject to a noise in the ear, together with a feeling of pressure on the head. Two months ago he complained of an attack of tooth-ache, during which the deafness was partially relieved; but lately it has become worse again, accompanied by a feeling of pressure in the ears: he has also had frequent attacks of giddiness and confusion in the head. On examining the right ear, the middle part of the meatus was seen to be occupied by a bony tumour which fills the whole of the tube, with the exception of a small space about three-fourths of a line in diameter, situated at its superior part. This space was observed to be closed by a white substance, which, on being touched with the probe, proved to be of great density. As it appeared probable that part, at least, of the symptoms above detailed depended upon the collection of epidermis behind the bony tumour, and its pressure upon the membrana tympani, it was thought desirable to attempt its removal. Small portions were picked away by the point of a probe, and the syringe was used; it was, however, so hard that only minute particles could be detached. A solution of carbonate of soda was directed to be applied constantly for some days, and then a further quantity was extracted, which mitigated the symptoms. By pursuing this plan, the whole of the matter beyond the tumours, which was found to be epidermis, was got rid of; and the patient not only heard better, but the unpleasant symptoms of giddiness and cerebral

irritation entirely disappeared. Judging from the large quantity of epidermis removed in comparison with the small space between the tumour and the membrana tympani, that substance must have been greatly compressed, and the membrana tympani also subjected to much pressure. In the year 1852, and again in the present year, the same gentleman consulted me on account of similar symptoms, which were wholly removed by the use of the syringe alone.

II. Molluscous Tumours.

Molluscous tumours are sometimes formed in the external meatus, and lead to very serious results. I first met with these tumours when making dissections of the ear, and several specimens are in my possession, which well illustrate the nature of the disease. These excrescences seem to have their origin in the dermis of the meatus, and they gradually increase in size so as not only to fill the whole of the meatus, but to encroach



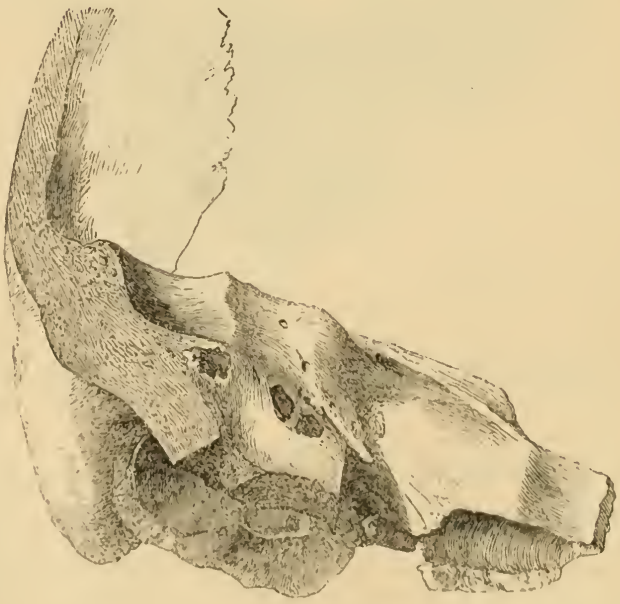
MOLLUSCOUS TUMOUR FILLING THE WHOLE OF THE MEATUS EXTERNUS.

upon and cause absorption of the bone. Thus, in some instances, the lower osseous wall of the meatus is affected, and in part absorbed, while in others the tumour extends upwards, and the whole of the upper wall of the meatus is effaced by the pressure exerted upon it. I have met with cases in which the tumour has extended into the cerebral cavity. These cases are liable to be overlooked, and classed with those in which there is a simple accumulation of epidermis in the meatus.

The treatment of molluscous tumours consists in removing the large mass of scales contained in the tumour, and afterwards

CAVITY IN THE MEATUS EXTERNUS FROM WHICH A MOLLUSCOUS TUMOUR HAS BEEN REMOVED.

syringing the meatus abundantly with warm water twice or thrice daily.



APERTURES IN THE UPPER WALL OF THE MEATUS EXTERNUS COMMUNICATING WITH THE CEREBRAL CAVITY, PRODUCED BY A MOLLUSCOUS TUMOUR.

Case. Molluscous tumour in the external meatus; discharge

from the ear.—Mr. G., between 40 and 50, consulted me for a discharge from the right ear, accompanied by deafness. On examination the meatus was observed to be nearly full of a white caseous-looking matter, from which oozed a discharge. By persevering use of the syringe, aided by the forceps, a large white mass was removed, which was found to consist of layers of white matter, composed of large scales, similar to those of other molluscous tumours. On the removal of the mass the discharge disappeared.

In bringing to a conclusion these observations on the diseases of the external meatus, it will be well to draw attention to the morbid conditions disclosed by the dissection of 1013 diseased ears. They were as follows :—

Containing a collection of cerumen	71
Containing a collection of cerumen and epidermis	9
Distended and dilated by a collection of cerumen	5
Distended and dilated by a collection of cerumen and epidermis	1
Containing a collection of cerumen and rye seeds	2
Containing a collection of cerumen, the osseous walls being absorbed in parts	3
Containing a collection of cerumen and epidermis, the osseous walls being absorbed in parts	4
Containing a collection of cerumen, the osseous walls being absorbed in parts, so as to expose the cavities of the mastoid cells	1
Containing a collection of hairs	1
Containing a collection of cotton wool	1
Containing a molluscous tumour	5
Containing a molluscous tumour, the osseous walls being absorbed in parts	3
Containing a molluscous tumour which projects through the bone into the cerebral cavity	1
Containing a molluscous tumour which projects into the mastoid cells	1
Containing a collection of pus	10
Containing a collection of pus mixed with epidermis	1
Having polypi growing from its walls	1
Having polypi growing from its walls, the bone being carious	1
The dermoid layer so much atrophied as to leave the bone denuded	2
The dermoid layer hypertrophied	2
The dermoid layer congested	7
The dermoid layer soft	1
The dermoid layer soft and red	2
The dermoid layer soft and detached from the bone	2

The dermoid layer soft and thick, the bone being carious	1
The dermoid layer ulcerated, the bone being carious	1
Osseous walls rough	1
Osseous walls carious	7
Osseous walls absorbed in parts	2
Osseous walls presenting an orifice superiorly	3
Osseous walls presenting an orifice inferiorly	1
Osseous canal much contracted	3
Having bony growths from the osseous walls; canal much contracted	14

CHAPTER VIII.

THE MEMBRANA TYMPANI.

STRUCTURE AND FUNCTIONS.

THE EPIDERMOID LAYER—THE DERMOID LAYER—THE FIBROUS LAYERS:—THE RADIATE FIBROUS LAYER—THE CIRCULAR FIBROUS LAYER—THE MUCOUS LAYER—TENSOR LIGAMENT—FUNCTIONS OF THE MEMBRANA TYMPANI.

Anatomical Observations.—There are so many points of interest in Pathology connected with the structure of the membrana tympani, which bear upon its morbid conditions, but which have not hitherto been sufficiently recognised, that the subject deserves a full examination. Looked at from without inwards, the membrana tympani may be described as consisting of the following layers:—

1. The epidermis.
2. The dermis.
3. The fibrous layer, composed of—
    a. The lamina of radiating fibres.
    b. The lamina of circular fibres.
4. The mucous membrane.

The *epidermis* is a thin layer, covering the outer surface of the dermoid lamina; it is continuous with the epidermis of the external meatus, and, when subjected to the process of maceration, can be removed in the form of a small blind pouch, which presents, as it were, a cast of the meatus and of the external surface of the membrana tympani. When floating in water, the pouch reassumes the form it had when in contact with other tissues, and its internal extremity is convex, corresponding with the external concavity of the membrana tympani. The layer of epidermis forming the outer coat of the membrana tympani is

thin, and in the living subject so transparent that the dermoid layer can be distinctly seen through its substance; its outer surface is very smooth, and capable of reflecting light; and there is usually seen at its anterior and inferior part, a triangular shining spot.

THE TRIANGULAR SHINING SPOT AT THE ANTERIOR AND INFERIOR PART OF THE OUTER SURFACE OF THE MEMBRANA TYMPANI.

In the course of dissection, I have more than once found this delicate epidermis to be the only layer remaining, over portions varying from a line to a line and half in breadth, and yet appearing to have been sufficient to close the cavity of the tympanum and to preserve the power of hearing nearly perfect. The knowledge of this condition of the membrana tympani ought to lead to a cautious use of the syringe when no cerumen is present, since its application may cause a rupture of the epidermis.

The *dermoid layer*, as its name implies, is continuous with the dermis lining the external meatus, and is situated between the epidermis and the radiate fibrous layer. It is extremely thin, and secretes the epidermis. Previous to the publication of a paper by me on the structure of the membrana tympani, in the "Philosophical Transactions" for 1851, it had been supposed that the epidermis was secreted by the radiate fibrous layer. The presence of the dermis is best demonstrated by carefully dissecting, under water, the membranous meatus from the upper sur-

face of the osseous tube, as far as the attachment of the membrana tympani; at which point the periosteum of the meatus is seen to become continuous with the radiate fibrous lamina; this being cut through, the dermoid layer is detected passing down over the outer surface of the radiate fibres, and separating them from the epidermis. If the upper portion of this layer be drawn gently downwards by one hand, by means of a fine needle in the other, the delicate cellular tissue which connects it with the fibrous lamina can be broken up, and the dermis removed entire. The presence of this lamina may also be shown by introducing between it and the radiating fibrous layer, at the superior part of the membrana tympani, a fine bristle, by passing which down the cellular tissue is lacerated.

THE DERMOID LAYER OF THE MEMBRANA TYMPANI CONTINUOUS WITH THE DERMIS LINING THE UPPER WALL OF THE MEATUS EXTERNUS.

In a healthy state, when uninjected by blood or by artificial means, the dermoid lamina is thin and transparent, and its structure, under the microscope, looks like areolar tissue. When injected, however, this membrane is seen to have numerous blood-vessels ramifying through it, so as to form an elaborate plexus: these vessels, when enlarged, impart the red appearance to the surface of the membrana tympani so frequently met with during life. It is upon the supply of nerves to this lamina that the exquisite sensibility of the membrana tympani depends.

A knowledge of the existence of the membrane just described is of interest to the anatomist, who recognises in it the secreting organ of the epidermoid layer of the membrana tympani; and to the surgeon, who through its presence is enabled to understand phenomena occurring in certain diseases of the ear. There are peculiar diseased conditions in which the dermoid layer of the membrana tympani becomes much hypertrophied.

The proper *fibrous layer* of the membrana tympani can be easily separated into two laminæ, which are named from the direction of their component fibres. Previous to describing these

structures, it is desirable to cite the opinions of eminent anatomists concerning them.

In the Croonian Lecture published in the 19th volume of the "Philosophical Transactions," Sir Everard Home advanced the opinion that the membrana tympani in the human subject was muscular. His words are: "When viewed in a microscope, magnified twenty-three times, the muscular fibres are beautifully conspicuous, and appear uniformly the same throughout the whole surface. There being no central tendon as in the diaphragm, the muscular fibres appear only to form the internal layer of the membrane, and are most distinctly seen when viewed on that side."* The use of this radiated muscle, Sir Everard states, is "to give those different degrees of tension to the membrane which empower it to correspond with the variety of external tremors."† Since the first publication of this opinion as to the muscularity of the membrana tympani, anatomists, though generally conceding that it is fibrous, have widely differed as to its composition. According to Mr. Quain and Dr. Sharpey, "It is made up of fine closely-arranged fibres, the greater number of which radiate from near the centre to the circumference; but within these are circular fibres, which are more scattered and indistinct, except close to the margin of the membrane, where they form a dense, almost cartilaginous ring."‡ Mr. Wharton Jones writes: "The proper membrane can be divided into two layers—an outer thin one, consisting of radiating fibres, and an inner thicker layer, which is less distinctly fibrous, though when torn it does indicate a fibrous disposition, and that in a direction opposite to the former. . . . The fibres which cross the radiating ones are more aggregated at the centre; they run parallel with the handle of the malleus, and turn round its extremity. At the circumference of the proper membrane, there is a thick, firm, ligamentous or cartilaginous ring, which is fixed in the groove of the bone. The ligamentous ring appears to be formed by an aggregation of the circular fibres interwoven with the peripheral extremities of the radiating ones."§

By careful dissection the fibrous layers of the membrana tym-

* Loc. cit., p. 5. † Loc. cit., p. 11.

‡ Elements of Anatomy, 5th Edition, 1848, Vol. II., p. 932.

§ Cyclopædia of Anatomy and Physiology, Vol. II., p. 545.

pani may be separated into two distinct laminæ, the fibres of which have no intercommunication. The external layer may be called the *radiate fibrous lamina*, since its fibres radiate from the malleus to be attached to the cartilaginous ring; and the internal, the *circular fibrous lamina*. The radiate layer is the thicker and stronger of the two. So readily may the layers be separated from each other, that they are detached with more facility than the circular layer can be freed from the mucous membrane.

(*a.*) *The radiate fibrous layer.*—If the whole of the membrana tympani be carefully removed, there will be observed at its circumference a white, dense ring, apparently cartilaginous, which is received into the osseous groove of the temporal bone appropriated to it. It will be remembered, however, that this groove occupies only about five-sixths of the circumference of the inner extremity of the meatus, the upper sixth being smooth instead of grooved. The cartilaginous ring at the upper part is attached to the malleus, the anterior extremity being inserted into the anterior, and the posterior extremity into the posterior, part of the cervix of this bone: to the outer surface of this ring is attached the periosteum lining the external meatus. If the radiate lamina be examined with a magnifying power of ten or twelve diameters, fibres will be observed whose peripheries are attached to the cartilaginous ring, and their other extremities to the malleus. The uppermost of these fibres, however, must be excepted from the observation just made; for instead of passing from the superior part of the ring to the malleus, they take their course in front of the processus brevis, and form a distinct layer of membrane covering its outer surface. The disposition of this portion of the radiating fibrous lamina is interesting alike to the anatomist and surgeon, for it is observed to be continuous with the periosteal lining of the upper part of the

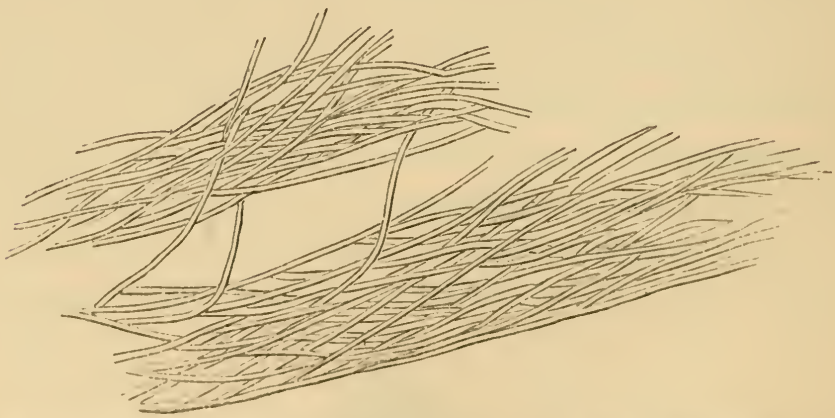
THE RADIATE FIBROUS LAYER OF THE MEMBRANA TYMPANI.

external meatus. Mr. Shrapnell, perceiving that this portion of the membrana tympani was not so tense as the rest, considered

it to be a distinct structure, and named it the "membrana flaccida."

Directly below the processus brevis of the malleus, the radiating fibres are attached to the ridge occupying the external surface of the bone; but at this part the fibres from each half of the membrana tympani are inserted so near to each other that no portion of the malleus is visible when viewed exteriorly. Towards the inferior extremity of the long process, however, the fibres being attached to the sides and not to the anterior surface, a small portion of the external surface of the long process, at its inferior part, is left bare and in contact with the dermoid layer; as may be distinctly seen in the healthy living ear by the aid of the speculum auris and a magnifying lens. The fibres extending from the malleus, and forming the posterior, are one-fourth larger than those forming the anterior segment of the membrane. The thickest part of this layer surrounds the extremity of the long process of the malleus, and the most attenuated lies between the posterior margin of the long process of the malleus and the circumference of the membrana tympani.

Structure of the radiate lamina.—The fibres composing the radiate lamina, when examined in a fresh state by the microscope, are translucent, and, with the exception of a few transparent globules, present no peculiarity of structure. The longitudinal

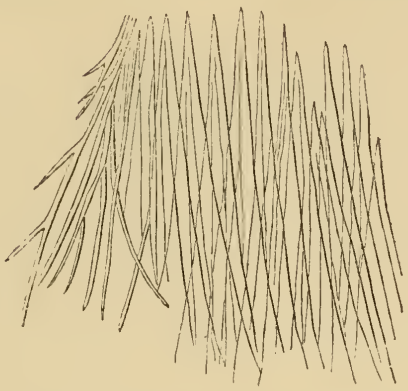


THE FIBRES COMPOSING THE RADIATE FIBROUS LAMINA (MAGNIFIED ABOUT 300 DIAMETERS).*

parallel wavy lines, however, characteristic of ordinary fibrous membranes, are absent. The fibres are flat, and vary from $\frac{1}{400}$

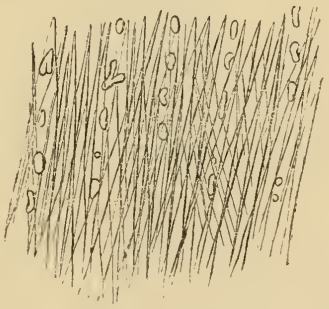
* In the other drawings from the microscope, the same magnifying power was used.

to $\frac{1}{5000}$ of an inch in breadth. In passing from the circular cartilage to the malleus these fibres interlace, giving rise to the



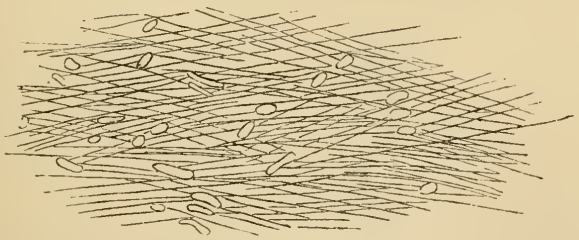
THE RADIATE FIBROUS LAMINA; EXTERNAL SURFACE DISPLAYING THE PECULIAR MARKINGS CAUSED BY THE INTERLACEMENT OF THE FIBRES.

peculiar diamond-shaped markings observable on the outer surface of the membrane. When treated with acetic acid, this



THE RADIATE FIBROUS LAMINA, AFTER HAVING BEEN TREATED WITH ACETIC ACID.

lamina becomes opaque, and sometimes, but not invariably, elongated oval nuclei are detected, the long axes of which correspond



THE CIRCULAR CARTILAGINOUS BAND, AFTER HAVING BEEN TREATED BY ACETIC ACID.

with the course of the fibres. In no instance, however, was an oval nucleus visible in an isolated fibre.

The circular white band at the circumference of the radiate fibres consists of a firm, slightly elastic mass of tissue, and pre-

sents an indistinct appearance of fibres intermixed with oval-shaped nuclei. Under acetic acid this structure loses its white aspect, becomes translucent, and discloses a great number of the oval nuclei.

(*b.*) *The circular fibrous lamina.*—This membrane, as previously stated, is attached to the radiating fibres by fine cellular tissue, and can be readily separated; for, as before observed, the fibres of each lamina are quite distinct and never intermingle. As its name implies, this lamina consists of circular fibres, which are firm and strong at the circumference, but so attenuated towards the centre, as to be detected only by careful observation. The strong fibres at the circumference of the layer form a complete circle, and are attached to each side of the body of the malleus, and to the sides of the upper third of the processus longus.

THE EXTERNAL SURFACE OF THE CIRCULAR FIBROUS LAMINA; THE FIBRES BEING ATTACHED TO THE PROCESSUS LONGUS OF THE MALLEUS. (SLIGHTLY MAGNIFIED.)

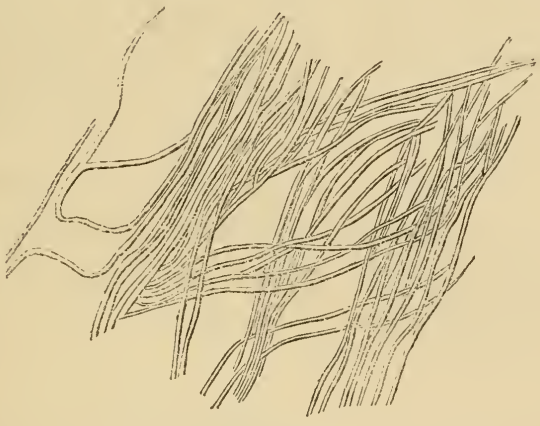
When closely examined by a magnifying power of thirty to forty diameters, the circular fibres are seen to be intersected by others of an extremely delicate character, which, increasing in number towards the centre of the lamina, become there so intimately blended with the circular fibres that the latter are not easily distinguishable. The central thin portion of the circular lamina is not attached to the malleus, but the fibres from each side are continuous, and form a membranous layer by a series of concentric fibrous circles; the outer surface being in contact with the inner surface of the lower half of the long process of the malleus, to which it adheres by loose cellular tissue. The circular fibrous lamina is entirely unconnected with the cartilaginous ring into which the radiating fibres are inserted; but is continuous with, and may be considered a modification of, the periosteal lining of the tympanic cavity. When the lamina of circular fibres is detached from the radiating layer, it will be found slightly concave externally, though less so than the outer layer. In its separate condition it is also not quite so concave as

when it was connected with the inner surface of the radiating fibres; but when its central portion is pressed inwards, so as to

THE INTERNAL SURFACE OF THE CIRCULAR FIBROUS LAMINA; THE LONG PROCESS OF THE MALLEUS IS SEEN THROUGH THE TRANSLUCENT CENTRAL PART. (SLIGHTLY MAGNIFIED.)

increase the concavity, its inherent elasticity causes it quickly to resume its former saucer-like shape. If the two layers, when detached, be placed side by side, the greater degree of external concavity in the radiating fibrous layer is very perceptible.

Structure of the circular lamina.—When highly magnified, the fibres of the circular lamina are found to be smaller than those of the radiate fibrous layer, and to vary from the 6000th to the 10,000th of an inch in breadth. The outer fibres run parallel with each other, and do not interlace; they are diaphonous, and free from any wavy longitudinal lines. Under

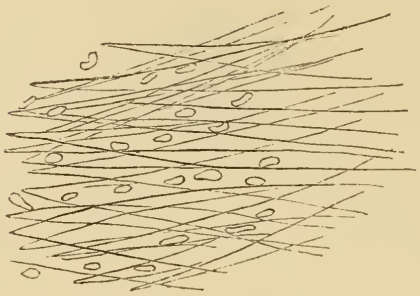


THE FIBRES COMPOSING THE CIRCULAR FIBROUS LAMINA.

acetic acid, the fibres enlarge and assume a certain degree of opacity; and in some instances this lamina also presents distinct oval nuclei elongated in the direction of the fibres; but as in the radiate lamina, never in the separate fibres, and most commonly they are not present.

It is often not easy to decide whether a structure is muscular: hence doubts may arise as to the true nature of the two fibrous

laminæ of the membrana tympani. My own researches do not seem to favour the view of that membrane being a contractile



THE FIBRES OF THE CIRCULAR FIBROUS LAMINA TREATED WITH ACETIC ACID.

tissue. The facts which appear to militate against the idea of its being muscular, are:—

1st. The absence of distinct nuclei in the fibres.

2nd. The great denseness and hardness of the latter, and their firm and unyielding structure, they being so strong as to be with difficulty torn across.

(*c.*) The *mucous membrane* forming the inner layer of the membrana tympani is, in the healthy ear, so extremely thin as to be with difficulty detected; though by careful dissection it may be removed entire from the inner surface of the circular fibres, with which it is connected with considerable firmness by fine cellular tissue.

It will now be evident that of all the laminæ which constitute the membrana tympani, not one is proper to that organ; all of them being directly continuous with other structures, of which they appear to be modifications. Thus:—

THE RADIATE FIBROUS LAMINA, THE CIRCULAR FIBROUS LAMINA, AND THE MUCOUS MEMBRANE OF THE MEMBRANA TYMPANI, SEEN TO BE CONTINUOUS WITH THE OTHER STRUCTURES. (SLIGHTLY MAGNIFIED.)

1st. The *epidermis* is continuous with that lining the external meatus.

2nd. The *dermis* is continuous with the dermis of the meatus.

3rd. The fibrous lamina consists of the *radiate fibrous lamina*, which is a prolongation of the periosteal lining of the external meatus; and of the *circular fibrous lamina*, a prolongation of the periosteum of the tympanum.

4th. The layer of *mucous membrane* forms part of the lining of the tympanic cavity.

Previous to considering the functions of the fibrous laminæ of the membrana tympani, it is desirable to advert to another point in the structure and relations of this organ. It has been already stated that the membrana tympani is attached, at its circumference, to the temporal bone, and, at its central part, to the malleus, which latter bone is so suspended by means of the processus gracilis and the short process of the incus, that the long process can move inwards towards the tympanic cavity, and outwards towards the meatus. It must be evident, therefore, that in order to prevent the concave membrana tympani, with the above attachments, from remaining in a state of relaxation, either the tensor tympani muscle must be in a state of continual contraction, or some other provision must exist for retaining the membrana tympani in the moderately tense condition fitting it to receive the sonorous undulations. This provision actually exists, and, as far as I am aware, has hitherto escaped the attention of anatomists: it is *the tensor ligament of the membrana tympani.*

The ligament in question is about three-fourths of a line in length, and is attached internally to the cochleariform process, and externally to that part of the inner surface of the malleus where the long process joins the neck. In the interior of this ligament, which is tubiform, is placed the tendon of the tensor tympani muscle. Anteriorly the ligament is thin, consisting of very delicate fibres; but the remainder is thick, dense, and composed of firm ligamentous tissue. So long as it remains entire and the membrana tympani uninjured, the latter structure retains its natural degree of concavity and tenseness: but when the ligament is cut through, or there is a solution of continuity, resulting from disease, the membrana tympani becomes very flaccid, even though the tendon of the tensor tympani muscle

remains entire. When the tensor tympani muscle is pulled, in a preparation of the parts, the membrana tympani is rendered very tense, and the tensor tympani ligament relaxes; but so soon as the muscle relaxes, the membrana tympani returns to its usual state, and the ligament again becomes tense.

THE ATTACHMENTS OF THE TENSOR TYMPANI LIGAMENT; THE TENDON OF THE TENSOR TYMPANI MUSCLE IS DRAWN UPWARDS SO AS TO LEAVE THE LIGAMENT ISOLATED. (SLIGHTLY MAGNIFIED.)

On the functions of the fibrous laminæ of the membrana tympani.—It is obvious that one use of the fibrous laminæ of the membrana tympani is to present a firm but delicate membranous septum for the reception of sonorous undulations. The arrangement of the two sets of fibres at right angles to each other, has the effect of imparting great strength, combined with extreme delicacy and tenuity, to the membrane. As stated, there is no evidence to prove that the fibres of which the membrana tympani is composed possess in themselves any contractile power; neither do the component fibres of the laminæ appear to evince more than an extremely slight degree of elasticity. An examination, however, of the structure after death, shows that it has an inherent power of returning to its natural state after being unusually distended. Thus, if the membrana tympani be exposed without interfering with its natural state of tension, and the canal containing the tensor tympani muscle be laid open, so that the muscle can be drawn towards its origin, the external concavity of the membrana tympani can be increased till it becomes very tense; but as soon as the muscle is let go, the membrana tympani will be observed to resume its former condition. This action is explainable partly by the slight elasticity of the circular cartilaginous band, into which the peripheral extremities of the radiating fibres are inserted, and partly by the slight elasticity of these fibres themselves; but more especially by the peculiar arrangement of the circular

fibrous lamina, which has always a tendency, when left to itself, to assume a more shallow form. Thus when the membrane is rendered very concave, the circular fibres are slightly separated from each other; but when the extra tension ceases, the fibres intersecting the circular ones aid in drawing the latter together again.

The disposition of the central region of the circular lamina also assists it in bringing back the membrana tympani to its natural state after tension by the tensor tympani muscle. It has been stated that the middle part of these circular fibres, instead of being attached to the handle of the malleus, is applied against its inner surface, and thus the membrane is further rendered tense by the pressure of the long process of the malleus against its outer surface during the action of the tensor tympani muscle; and when this muscle ceases to act, the central part of the circular layer reacts on the malleus and constrains it to resume its usual position. Besides the office of bringing the membrana tympani to its natural state after the action of the tensor tympani muscle, the circular fibrous layer would appear to be always acting as an antagonist to the tensor tympani ligament; so that by the continued action of these two tissues—the one drawing it inwards, the other outwards—the membrana tympani is kept in a state adapted to receive all the ordinary sonorous undulations, independent of any exercise of muscular power.

The functions of the membrana tympani.—Anatomists generally consider that the use of the membrana tympani is to receive the sonorous undulations from the air of the meatus, and conduct them to the ossicles, by which they are conveyed to the labyrinth. Whether vibrations are conducted to the labyrinth through two media, or through the air alone, there can be no doubt that the membrana tympani is the agent whereby the vibrations are conveyed from the meatus externus to the tympanum. I shall, in a future part of this volume, try to prove that another function of the membrana tympani is, in conjunction with the muscles and bones of the tympanum, to act as the analogue of the iris of the eye: and thus, firstly, shut out from the internal ear, or at least modify, the effect of loud vibrations; and, secondly, render the ear susceptible of the more delicate undulations.

Whatever opinion may be held respecting the functions of the membrana tympani, there can be no doubt that its integrity is essential to the due performance of its functions, as also that it should retain its natural degree of resiliency, and that its muscles should be able to move it with ease.

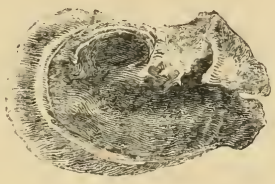
CHAPTER IX.

THE MEMBRANA TYMPANI (*continued*).

THE EPIDERMOID LAYER—DERMOID LAYER—(*a*) ACUTE INFLAMMATION—TREATMENT—CASES—(*b*) CHRONIC INFLAMMATION—CASES—(*c*) ULCERATION—CASES. FIBROUS LAMINÆ—(*a*) ACUTE INFLAMMATION—(*b*) CHRONIC INFLAMMATION—(*c*) ULCERATION—(*d*) CALCAREOUS DEGENERATION—(*e*) RELAXATION OF THE MEMBRANA TYMPANI—TREATMENT—CASES.

In describing the diseases of the membrana tympani, I shall speak in succession of its epidermoid, dermoid, and fibrous layers, leaving the consideration of the mucous layer till the diseases of the tympanic cavity come under review.

I. *The Epidermoid Layer.*—This layer is sometimes secreted in such large quantities as to form a mass several lines in thickness on the outer surface of the dermis. In some cases I have known this mass to be composed of six or seven laminæ, closely packed upon each other. The symptoms attendant upon this accumu-



EPIDERMOID LAYER OF THE MEMBRANA TYMPANI HYPERTROPHIED. (MAGNIFIED THREE DIAMETERS.)

lation are analogous to those of accumulation of epidermis in the meatus; there is also often a great degree of cerebral irritation from the pressure on the chain of ossicles. The treatment is similar to that employed where there is accumulation of epidermis in the meatus externus. A syringe and warm water are usually sufficient to loosen and bring away the mass. Should they not be so, a few drops of water or soap and water, dropped into the meatus for a day or two, will loosen and facilitate the removal of the mass. As a general rule, the symptoms of deaf-

ness and discomfort in the head wholly disappear with the extraction of the collection.

II. *The Dermoid Layer.*—This layer of the membrana tympani, like the dermis of the meatus, is subject to acute and chronic inflammation, and also to ulceration. On account of the intimate relations existing between the dermoid and fibrous layers of the membrana tympani, it is of great importance to put a stop to these affections of the dermis, since they are apt to be prolonged to the deeper-seated layers of the organ.

(*a.*) ACUTE INFLAMMATION OF THE DERMIS.

Acute inflammation of the dermis usually occurs in debilitated subjects, and is produced by the application of cold, or cold water, or any foreign body to the surface. The exciting causes are sudden exposure to cold air after being in a warm room, or cold water finding its way into the ear while bathing; often also it arises from the extension of inflammation from the dermis covering the meatus. The symptoms of this kind of inflammation are slight pain at the bottom of the meatus (aggravated by coughing, sneezing, and at times by swallowing), also not unfrequently an itching, with slight dulness of hearing. On examination the outer surface of the membrana tympani is seen to be dull, and the dermoid layer opaque; its blood-vessels being distended with blood. All the vessels bordering on the malleus are very much larger than natural, and frequently form two red lines, one running on each side of the long process of the malleus. After a few days a discharge of mucus often takes place. This affection, if left unsubdued, is apt to advance to ulceration, and the fibrous layers are also liable to be destroyed.

Treatment.—The treatment is very similar to that for acute inflammation of the dermoid meatus. One or more leeches should be applied to the margin of the orifice of the meatus, warm water should be syringed into it thrice or oftener daily, hot fomentations used all around the ear, and, if requisite, aperient medicines and calomel administered. Most usually the inflammation (seldom accompanied by discharge, though a small quantity sometimes issues from the surface of the membrane) soon succumbs to this treatment, and the fibrous laminæ escape uninjured.

Case I. *Acute inflammation of the dermoid layer of the membrana tympani.*—G. W., Esq., aged 60, consulted me on February 15th, 1853, on account of pain in his right ear.

History.—Without assignable cause, slight pain occurred in the right ear several days ago, which has remained till now, being aggravated at times. It is increased by coughing, and slightly when swallowing. A sensation of fulness is also complained of. On *examination*, I found the dermoid layer of each membrana tympani to be more opaque than natural, and numerous blood-vessels, especially at the upper part, were observed to be distended with blood. There was but slight diminution in the power of hearing.

Treatment.—As the pain was not very severe, the ear was ordered to be syringed out with warm water twice daily, a linseed meal poultice to be applied over the ear at night, and a stimulating liquid to be rubbed over the back of the ear. The pain gradually ceased, and the membrane returned to its natural state.

Case II. *Acute inflammation of the dermoid layer of the membrana tympani.*—B. S., Esq., a medical man, aged 48, saw me in February, 1852.

History.—When a student, twenty-six years previously, he had an attack of cold, and became suddenly deaf in both ears, but recovered in the course of two months. Sixteen years ago had an attack of vertigo, and suddenly lost the use of the left ear: the hearing partially returned, but still remains dull. A fortnight before consulting me he had relaxation of the throat, with an uncomfortable feeling in the left ear, and again became dull of external hearing, though the sound of his own voice was like thunder. On *examination*, the membrana tympani was observed to be swollen and much redder than natural; its blood-vessels being large and distended. Watch heard at a distance of two feet.

Treatment.—Slight counter-irritation was kept up behind the ear, and a cooling lotion applied to the meatus for ten days; at the end of that time the patient quite recovered.

Case III. *Acute inflammation of the dermoid layer of the membrana tympani. Discharge of viscid mucus.*—Master S., aged 3, was brought to me by his father, a physician in London, on the 19th April, 1853.

History.—A few days previously, when not feeling very well, complained of slight pain in each ear, which continued for two days, and was followed by a discharge of mucus, with slight dulness of hearing. The latter symptoms have remained until the present time.

On *examination*, each external meatus was observed to be partially filled with matter, which was removed by the syringe, and found to be composed of masses of mucus, similar in character to those issuing from the meatus in cases of acute inflammation of the dermis. They were more flocculent, whiter, but not so elongated as in the secretion from the mucous membrane of the tympanum. After the meatus had been cleansed, the outer surface of the membrana tympani was seen to be of a deep red colour, and to project outwards into the cavity of the meatus. More minute inspection showed that this red appearance depended upon the tumefaction of the dermoid layer of the membrane, which being denuded of epidermis, the processus brevis of the malleus was observed at the uppermost part. The hearing was very dull.

Treatment.—A leech was ordered to be applied to the margin of the orifice of each meatus, and hot poultices to be kept over the ears. By these means the pain was subdued, and the inflammatory symptoms abated. In the course of three days a small portion of vesicating paper was applied behind each ear. The power of hearing returned by degrees, the discharge disappeared, and the dermoid membrane regained its natural appearance.

Case IV. *Acute inflammation of the dermoid layer. Secretion of mucus.*—A. Moorman, aged 58, was admitted under my care at the St. George's and St. James's Dispensary, on May 24th, 1850.

History.—During the last five months has felt much debilitated. About seven weeks previous to seeing me, pain suddenly attacked the right ear, and was followed by a "steaming and hissing sound." After this sound had remained for three weeks, a discharge issued from the ear, which has continued to the present time, accompanied by a good deal of itching, and by a sensation as of something grinding within the ear. On *examination*, the watch was only heard when in contact with the ear; the dermoid layer of the membrana tympani was observed to be flat, red, and very much swollen; and there was a watery dis-

charge, consisting principally of epidermoid cells. The surface of the meatus was rather redder than natural.

Treatment.—The ear to be syringed with warm water twice daily; and vesicating paper to be applied each night behind the ear.

May 31.—Better; the noise less loud; the power of hearing increased.

June 7.—Improves daily: the quantity of discharge is much diminished; and the noises have ceased, with the exception of short occasional attacks. The membrana tympani is recovering its natural aspect.

(*b*) SIMPLE CHRONIC INFLAMMATION OF THE DERMOID LAYER, WITH OR WITHOUT AN ACCUMULATION OF EPIDERMIS.

This affection is also commonly produced by cold, but is of little importance, excepting when it results in the secretion of large quantities of epidermis. A simple tumefaction of the dermoid layer usually affects the hearing power too slightly to cause the patient to apply for relief: in many instances where the layer has been hypertrophied, the patients have suffered no inconvenience. If, however, it becomes so tumefied as to render the membrana tympani tense, then a perceptible deafness is induced. In the majority of cases of hypertrophy of the dermoid membrane, there co-exists a thickening of the mucous membrane of the tympanum, which causes the deafness. The presence of several layers of epidermis on the outside of the dermis, is also a source of considerable deafness, and very frequently of uncomfortable sensations in the ear and head.

Case I. *Simple chronic inflammation of the dermoid layer, with an accumulation of epidermis on its surface.*—Colonel T., aged 45, strong, and in good health, consulted me on July 1st, 1855, on account of a buzzing sensation in both ears, especially in the right, which had lasted for three months, accompanied by a feeling of oppression in the head and dulness of hearing. On *examination*, the watch was heard only when in contact with the ear, and a large quantity of epidermis was observed at the bottom of the meatus. By means of the syringe, several layers were extracted, and the surface of the dermis, which was red and thick, exposed. On the removal of the epidermis, the noises and unpleasant sensation in the head vanished, and the

hearing was much improved; the hearing distance with the watch being six inches.

Case II. *Chronic inflammation and hypertrophy of the dermoid layer.*—R. J., Esq., aged 25, visited me on March 29, 1853, on account of dulness of hearing.

History.—Five years ago, after a large portion of cerumen had been scooped out, had irritation in the ears, and remained deaf for some time afterwards. Three months ago, when suffering from deafness, was relieved by the use of the syringe; lately the left ear has again become dull, and he has complained of pain in it, and in the left side of the face. On *examination,* the right ear heard the watch at a distance of two inches; the left at the distance of an inch. The dermoid layer of each membrana tympani was hypertrophied, and that of the left ear was very red.

Treatment.—A slight discharge was kept up from the surface of each mastoid process, and a weak solution of nitrate of silver (gr. v. ad. ℥j) was applied to the surface of the affected membrane.

April 9.—Hearing improved. The watch is heard by the right ear at a distance of three inches; by the left, at a distance of seven inches.

(*c.*) CHRONIC CATARRHAL INFLAMMATION OF THE DERMOID LAYER.

This form of inflammation is far from being rare. Like the same disease of the dermoid layer of the meatus, it often occurs in children out of health, and also results from the application of cold to the surface of the membrane. It very frequently takes its origin in an attack of acute inflammation, which, instead of subsiding, becomes chronic. The discharge usually consists of the epidermoid cells, which are thrown off in conjunction with a quantity of fluid, instead of forming a distinct epidermoid layer. On removal of the discharge, the dermis is found to be swollen, and entirely denuded of epidermis; the colour of the surface varying from a deep to a palish red. The cases of this disease require the deepest attention, since they are apt to terminate in the formation of granulations or of polypi on the surface of the membrane, or in ulceration; the latter process endangering the fibrous laminæ. This affection is also not unfrequently associated with a corresponding one of the dermoid layer of the meatus; which may be subdued without the disease of the membrana tympani being cured.

Case I. *Chronic catarrhal inflammation of the dermoid layer, with thickening of the mucous membrane of the tympanum.*—Rev. W. A., æt. 32, visited me on the 18th of November, 1854.

History.—Since childhood the left ear has been useless. During the past year the right ear has been dull of hearing at times, and he has complained of irritation of the ear, for which he has been in the habit of using an earpick. Lately his deafness has so increased, that he has to be loudly spoken to within a yard of the head, and also complains of a discharge from the right ear. On *examination*, the dermis of the meatus in the *right ear* was observed to be red, while the dermoid layer of the membrana tympani was partly red and partly white: there was also an abundant discharge of mucus.

Treatment.—The ear to be syringed out with warm water thrice daily, three leeches to be applied to the orifice of the meatus, and vesicating paper to be kept behind the ear.

Nov. 26.—Much better: thinks he now hears as well as he has done for some years. The dermoid layer of the membrana tympani is less red: the discharge is less abundant.

Case II. *Catarrhal inflammation of the dermoid layer after bathing.*—Miss J. G., æt. 27, consulted me on September 15, 1855, on account of a dulness of hearing in the left ear, with discharge.

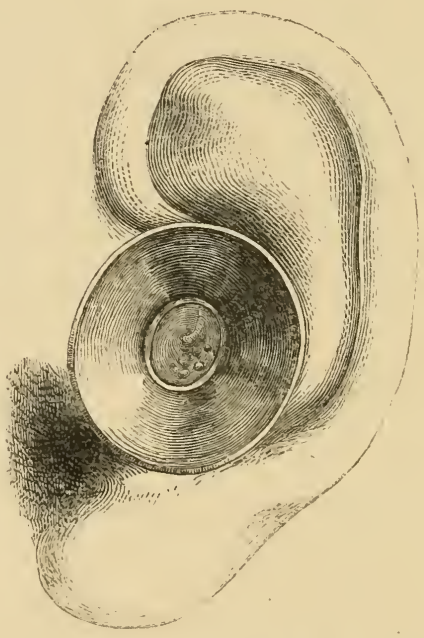
History.—A year previously, immediately after bathing in the sea, felt a slight pain in the left ear, which continued for three or four days, and was followed by a discharge, which has remained until now, accompanied by a dulness of hearing. On *examination*, the surface of the dermoid layer of the membrana tympani was found to be covered with discharge, which being removed, the membrane was seen to be red, and its blood-vessels distended. Under the same treatment as in the last case, the patient was cured in two months.

Case III. *Catarrhal inflammation of the dermoid layer after measles. Polypoid growth from the surface.*—Miss M. E. S., aged 10, not strong, was brought to me on April 2, 1853.

History.—Three years previously had an attack of measles, followed by discharge from the left ear, and considerable dulness of hearing in both. Eight months ago had an attack of low fever, which remained for two or three months, and much increased the deafness. At the present time has to be spoken to

distinctly within a yard of the right ear. Every night there is discharge, and a certain amount of ear-ache. Is better in warm weather.

On *examination*, there was found in the right ear a large quantity of discharge, which being removed, the dermoid layer was observed to be much hypertrophied, and red growths covered considerable portions of it, especially posteriorly. Hearing distance four inches.



GRANULATIONS ON THE SURFACE OF THE DERMOID LAYER OF THE MEMBRANA TYMPANI. (SEEN THROUGH THE SPECULUM.)

Left ear.—Membrana tympani white at the upper part, and the dermis much thickened: discharge abundant: hearing distance half an inch.

Treatment.—A solution of chloride of zinc, two grains to the ounce, was injected into each ear daily, and a discharge was kept up from the surface of the mastoid process. Under this treatment the discharge disappeared, and the power of hearing was greatly improved.

Case IV. *Catarrhal inflammation of the dermoid layer, following measles.*—Master M. N., aged 6, pale, thin, and of a scrofulous diathesis, was brought to me on the 12th of May, 1851, on account of a discharge from the right ear.

History.—Since infancy has been subject to attacks of ear-ache: five months ago had an attack of measles, followed by a

discharge from the right ear, which, though diminishing at times, has never wholly ceased. No dulness of hearing has been perceived.

On *examination*, the hearing distance of the right ear was found to be reduced to four inches; the meatus contained a large quantity of offensive discharge; the outer surface of the membrana tympani was flat; the dermis was white, and much thickened.

Treatment.—Tonic medicines were administered; the ear syringed out with half a pint of tepid water thrice daily, and afterwards with a solution of tannin, three grains to the ounce; and a stimulating liniment was rubbed over the mastoid process twice daily. This treatment, persevered in for two months, removed the discharge, diminished the hypertrophy of the membrane, and improved the power of hearing. The patient was brought to me three or four times subsequently, suffering from a recurrence of the attack, but it always yielded to similar treatment.

(*d.*) ULCERATION OF THE DERMOID LAYER OF THE MEMBRANA TYMPANI.

Ulceration of the dermoid layer is an affection only occasionally met with, and is either the result of long-continued catarrh of the dermis, or of the application to its surface of irritating matters, or of cerumen. The symptoms are very similar to those described in the previous section; there is, however, frequently a discharge of blood, and the pain is more severe.

Case I. *Ulceration of the dermoid layer from the presence of cerumen.*—Mrs. G., aged 40, saw me on May 26th, 1855.

History.—Fourteen days previously she had a singing in the left ear, which came on suddenly after fatigue, and has remained until the present period; it is accompanied at times with confusion in the head.

On *examination*, the meatus was found to be full of cerumen, and the watch was only heard when in contact with the ear. On removing the cerumen by a syringe and warm water, the outer surface of the membrana tympani was observed to be red. At its anterior part there was a small surface, about three quarters of a line in diameter, where the dermis had been wholly destroyed by ulceration; and there was also a small depression,

at the bottom of which the membrane was red. Hearing distance reduced to eight inches. No applications were made, and the ulcer healed in a few days.

Case II. *Ulceration of the dermoid layer; fibrous layers exposed.*—J. A., Esq., aged 35, was sent to me on March 26, 1850, by Mr. Mossop, of Whitehaven.

History.—Twenty years ago, had a polypus in the right ear, which was removed; but it grew again, and was a second time removed; since the last removal has had discharge at times from this ear. Three years previously had a severe cold, was very deaf for a week, and then gradually recovered; but since that attack has been very deaf during a cold. Is at present suffering from a cold, and is so deaf as to require to be loudly spoken to close to him.

Right ear.—On examination, the surface appeared to be red, and at the posterior part there was a small depression, from which the dermoid layer had been eroded by ulceration. When the tympanic cavity is distended, there is an outward bulging of the fibrous layers through the orifice in the dermis. Watch heard when in contact with the ear.

Left ear.—The dermoid membrane is white and thick, and discharge issues from its surface. Hearing distance half an inch.

Treatment.—A discharge was kept up over each mastoid process, and small doses of blue pill were administered: by degrees the hearing slightly improved.

Case III. *Ulceration of the dermoid layer. Discharge of blood.*—M. S. Chambers, aged 7, was admitted under my care at the St. George's and St. James's Dispensary, on January 18, 1850.

History.—A year and a half ago suffered from an attack of small-pox, from which she was very ill for six weeks. A few months after the attack, discharge suddenly issued from both ears, and has continued ever since, being very offensive, and at times mixed with blood: has lately been also subject to itching in the ears, ear-ache, pains in the forehead, and giddiness. On examining the right ear, its surface was observed to be red and tumefied, and there was an orifice, at the anterior part, through the whole of the laminæ.

Left ear.—The dermis is of a deep red, and its central portion has been destroyed by ulceration: when the tympanic cavity is distended with air, the fibrous layers bulge outwards.

The *treatment* consisted in the administration of tonics; in keeping up a discharge from the surface of the mastoid process; and in the use of gentle astringents. After several weeks the discharge gradually diminished, and all pain ceased.

3. *The fibrous laminæ.*—Although the two fibrous laminæ are so distinct in their structure and relations, their diseases are so similar, and they are usually so equally affected, that it is desirable to consider them together. The diseases to which they are liable are:—Acute inflammation, chronic inflammation, hypertrophy, ulceration, and calcareous degeneration.

(*a.*) ACUTE INFLAMMATION OF THE FIBROUS LAMINÆ.

When the fibrous layers of the membrana tympani are the seat of acute inflammation, the mucous membrane of the tympanum is usually similarly affected, which renders it difficult to define the symptoms of acute inflammation of the fibrous layers. This affection is usually excited by cold air striking the outer surface of the membrane: hence the suddenly passing from a heated room into cold air, especially in an easterly wind, often produces it. As in inflammation of the mucous membrane of the tympanum, there is commonly the predisposing cause of debilitated health. The *symptoms* of this affection are a tickling sensation deep in the ear, often accompanied by involuntary movements of the membrana tympani, consequent on the irregular action of the tensor tympani muscle. This sensation increases, and a severe lancinating pain ensues, which is increased by the act of deglutition, the use of the handkerchief, coughing or sneezing. On *examination*, the surface of the membrane is seen to be shiny, its colour more leaden than usual, tinged frequently with a reddish hue, from the distension of its vessels with blood. The affection commonly ends in resolution, but sometimes ulceration ensues, which will be afterwards described.

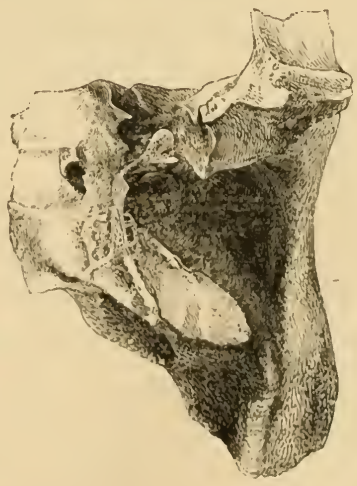
The *treatment* of this form of acute inflammation consists in the use of leeches to the margin of the orifice of the meatus, followed by hot fomentations and poultices; while calomel and opium are administered internally. Cases of this disease will be given under "acute inflammation of the mucous membrane of the tympanum."

(*b.*) CHRONIC INFLAMMATION AND HYPERTROPHY OF THE FIBROUS LAYERS.

In this affection, the fibrous layers continue for some time congested, or become opaque. This disease will be treated of at length under the head of "rigidity of the membrana tympani."

(*c.*) ULCERATION OF THE FIBROUS LAMINÆ OF THE MEMBRANA TYMPANI.

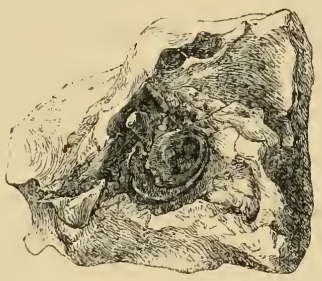
This affection commonly originates either in acute or chronic catarrhal inflammation of the dermoid layer; but sometimes it is the result of primary acute inflammation of the fibrous layers. It usually occurs in persons of debilitated health, and is often attended with considerable constitutional irritation. When it originates in catarrh of the dermoid layer, that membrane becomes destroyed in parts, and the outer surface of the radiate fibrous lamina is exposed to view. If in this state the membrana tympani be examined with a speculum and a strong light, the radiate fibrous layer is seen to form the floor of a depression, the margins of which are formed by the dermoid layer. In some cases this surface is covered by deep red granulations; in others, large portions of the fibrous laminæ are exposed, which pour out an abundant discharge without the presence of any granulations. After some of the fibres of the fibrous laminæ are



THE MEMBRANA TYMPANI FALLEN IN TOWARDS THE PROMONTORY, FROM WEAKNESS OF THE FIBROUS LAMINÆ. (SEEN IN SECTION.)

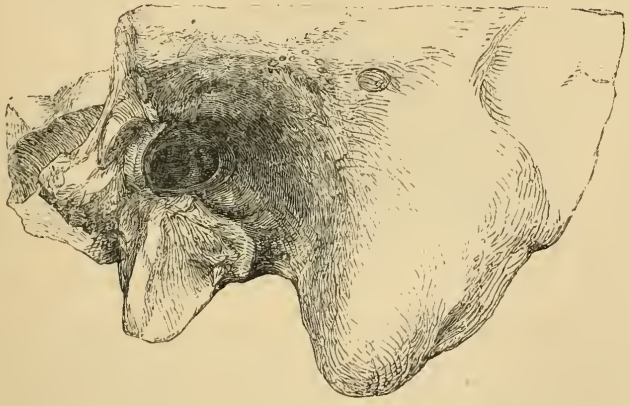
destroyed by the ulcerative process, the remaining fibres are so much weakened that the whole lamina falls inwards towards

the surface of the promontory, and thus the size of the tympanic cavity is greatly diminished. In other instances, a great portion of the fibrous lamina is entirely destroyed; and the mucous layer alone remains; or portions of all the laminæ are eroded, and a perforation is the result. Upon inspection, a case of perforation of the membrana tympani, produced by ulcera-



THE MEMBRANA TYMPANI FALLEN IN TOWARDS THE PROMONTORY, FROM WEAKNESS OF THE FIBROUS LAMINÆ. (SEEN FROM WITHOUT.)

tion of the fibrous laminæ, and advancing from without inwards, can always be distinguished from a case of perforation originating, as it more commonly does, in catarrh of the mucous membrane of the tympanum, and advancing from within outwards. In the latter class of cases, the margin of the orifice is sharp, smooth, and well defined; its shape is usually round or oval; and the remaining portion of the membrane, retaining its natural plane, is smooth: whereas, in cases of perforation from ulceration of the dermoid and fibrous layers, the margins and form of the orifice are irregular; and the plane



AN ORIFICE IN THE MEMBRANA TYMPANI PRODUCED BY ULCERATION OF THE FIBROUS LAMINÆ.

of the remnant of the membrane, deviating from the natural state, is often funnel-shaped, and very concave externally.

Ulceration of the fibrous layers of the membrana tympani

once established is liable to remain during many years, and is one of the diseases hitherto comprised under the term "otorrhœa." Sometimes a large part of the substance of the fibrous layers is entirely effaced, and the outer surface of the mucous membrane pours out a secretion. A singular accompaniment of this affection of the fibrous laminæ is a contraction of the carotid canal. I have so frequently found this condition where the membrana tympani has been ulcerated, and so rarely met with it under other circumstances, that I am induced to consider it as connected with the ulceration. The *treatment* to be pursued in cases of ulceration of the fibrous laminæ, consists in washing out the meatus frequently with warm water, and in applying, by means of a syringe, a weak solution of the nitrate of silver, or some other astringent, to the part affected. If the membrana tympani has been perforated, the use of an artificial membrana tympani will often be of service. A slight discharge should also be kept up from the surface of the mastoid process. Concurrently with these local applications, measures should be taken to strengthen the general health.

Case I. *Ulceration of the fibrous laminæ of the membrana tympani.*—W. W., aged 50, a medical man, residing in London, consulted me, in 1852, on account of a long-standing discharge from the left ear, accompanied by deafness.

History.—In early life, after repeated attacks of ear-ache, a discharge flowed from the left ear, which has not ceased for

THE FIBROUS LAYERS OF THE MEMBRANA TYMPANI ULCERATED OVER A SMALL EXTENT AT ITS ANTERIOR PART. THE MUCOUS MEMBRANE, REMAINING, FORMS A SMALL CUL-DE-SAC; SEEN EXTERNALLY. THIS ILLUSTRATION, FROM A PREPARATION IN MY MUSEUM, GIVES AN IDEA OF THE NATURE OF THE DISEASE.

more than a week or two at a time since that period. Lately there has been at times great deafness, producing extreme inconvenience, as the right ear has been useless during many years.

Upon syringing the left ear, a large quantity of offensive matter was removed, and the membrana tympani became distinctly visible. Its circumference was in a natural state, but at the central part the dermoid and fibrous layers had been destroyed by ulceration, so as to disclose the outer surface of the mucous layer. Instead of forming a septum in the situation of the natural organ, the membrane was nearly in contact with the outer surface of the promontory. Upon the patient swallowing with closed nostrils, the mucous membrane was observed to bulge outwards, and form a kind of bubble, which remained until the act of swallowing was repeated with the nose open, when the membrane again fell inwards. During the time the membrane projected outwards, the hearing power was greatly improved; but diminished as soon as it fell inwards.

The *treatment* consisted in syringing out the ear twice daily, so as to remove the discharge, in applying a weak solution of nitrate of silver to the outer surface of the membrane, and in keeping up a slight counter-irritation over the mastoid process. The result was, that the power of hearing improved, and the condition of the mucous membrane became so much strengthened that, instead of falling inwards towards the promontory, it was able to form a tympanic cavity. So long as that remained, the hearing was excellent; but if from any cause the mucous membrane fell inwards, the performance of the act of deglutition, during the closure of the nostrils, immediately restored it to its natural position, and improved the hearing.

Case II. *Ulceration of the fibrous laminæ of the membrana tympani.*—Mrs. E. C., aged 38, consulted me in June, 1850, on account of deafness in both ears, accompanied by giddiness and discharge.

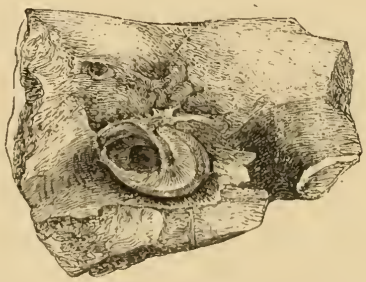
History.—Twenty years previously she had a bad cold, followed by deafness and a discharge from both ears; and the latter has continued to the present time. Has been subject to attacks of ear-ache, usually followed by an increase of the discharge, which, during a cold, is much more abundant, often becoming very offensive. During the last year has been much worse, complaining of much singing in the head, and giddiness. She requires to be distinctly spoken to within the distance of a yard. On *examination*, a quantity of fluid discharge having been removed from each meatus, the right membrana tympani at the posterior and lower part appeared white and thick, while the

anterior and upper part had fallen inwards, and appeared as if attached to the promontory; its outer surface was uneven, and poured out the discharge; air passed through the Eustachian tube. Hearing distance two inches.

Left ear.—Hearing distance one inch. The upper half of the membrana tympani had fallen inwards, was red, and poured out a discharge. The *treatment* consisted in keeping up a discharge from the back of the neck, in syringing out the ears twice daily, and in applying a solution of nitrate of silver (gr. xx ad ℥j) to the surface of the membrane. This treatment was pursued during two months: the discharge gradually disappeared; and the hearing was greatly improved.

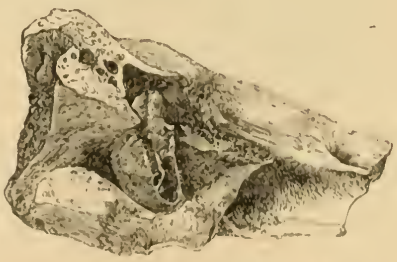
(*d.*) CALCAREOUS DEGENERATION OF THE FIBROUS LAMINÆ OF THE MEMBRANA TYMPANI.

The fibrous laminæ of the membrana tympani frequently undergo calcareous degeneration. This change occurs at all periods of life; sometimes taking place when the remaining portion of the membrane is healthy, and no other abnormal



CALCAREOUS DEPOSIT IN THE CIRCULAR FIBROUS LAMINA OF THE MEMBRANA TYMPANI.

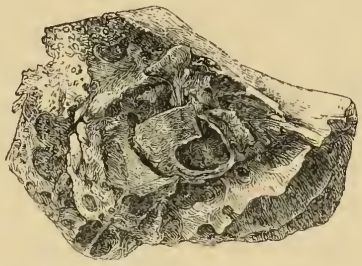
state can be detected in the organ. In some cases this calcareous condition of the membrane is symptomatic of



CALCAREOUS DEPOSIT IN THE RADIATE FIBROUS LAMINA OF THE MEMBRANA TYMPANI.

calcareous deposit within the tympanic cavity; in others, it follows, and appears to be produced by, chronic inflammation,

with or without catarrh of the dermoid layer. After ulceration and destruction of portions of the membrane, the residue is also at times converted into calcareous matter. Sometimes the calcareous matter is arranged in a circular form, when it will be found to be deposited in the circular fibrous layer; at other times it assumes a radiate form, and then the radiate fibrous layer is the seat of the deposit. In other cases the whole mass of the membrane is converted into calcareous matter. Where



THE WHOLE OF THE MEMBRANA TYMPANI CONVERTED INTO CALCAREOUS MATTER.

there is much diminution of the power of hearing in this disease, there is usually partial or complete anchylosis of the stapes to the fenestra ovalis, and any treatment must have for its object the diminution of the anchylosis. Patients applying for relief in such cases must therefore be treated by counter-irritation over the mastoid process, and by the administration of alteratives.

Case I.—M. C., aged 32, consulted me in December, 1854.

History.—When a child he had an attack of measles, followed by great diminution of the power of hearing, so that he has ever since been unable to hear unless the speaker's voice is raised higher than natural, and brought near to him. There has been discharge for many years from the right ear. On *examination*, the meatus of that ear was found full of thick discharge; when this was removed by the syringe, the upper half of the membrana tympani was seen to be calcareous, the lower half transparent. The Eustachian tube was pervious. Watch not heard when in contact with the ear; but the crack of the nail was heard at the distance of a foot.

Left ear.—The anterior half of the membrana tympani was calcareous; Eustachian tube pervious; hearing power the same as in the opposite ear. Gentle counter-irritation over the mastoid process was ordered. The patient was not seen a second time.

Case II.—J. G. T., Esq., aged 18, consulted me in 1855.

The general health was good, with no hereditary tendency to deafness.

History.—Five years previously dulness of hearing slowly appeared after an attack of influenza; two years subsequently suffered from scarlet fever, followed by discharge from each ear, and by a great increase of deafness. The discharge has now ceased; but there is so much deafness that he has to be loudly spoken to within three feet. At times, especially during a cold, ear-ache is complained of. On examining the right ear, the watch was heard at the distance of half an inch. The greater part of the lower half of the membrana tympani was converted into a mass of crescent-shaped calcareous matter, but the other part of the membrane was healthy. Eustachian tube pervious.

Left ear.—Watch heard on pressure over the ear and over the temple; the membrana tympani is more concave than natural; and there is a patch of calcareous matter, similar in shape and size to that of the right ear. Eustachian tube pervious. The same treatment was pursued as in the last case, and with some benefit.

Case III.—Mrs. B., aged 34, in good health, but subject to bilious attacks, consulted me in 1854.

History.—Since an attack of ear-ache when a child, the left ear has been useless. Three months ago the right ear became suddenly deaf after a cold; the deafness was treated by syringing, the operation being followed by slight bleeding, but no immediate improvement. After a few days, however, the hearing improved, but the ear was extremely sensitive, and there was a constant feeling of reverberation in it. When more than one person spoke at a time, confusion in the ear was produced, and, during the act of swallowing, a grating sound occurred in the organ. Noise like that of a waterfall is constantly present on the right side. On examining the right ear, the larger part of the membrana tympani was found calcareous; the Eustachian tube was pervious; the hearing distance was six inches. The membrana tympani of the left ear had so fallen in as to be in contact with the promontory. The watch was not heard, but the crack of the nail was heard at a distance of three inches. The treatment consisted in keeping up a slight discharge from the surface of the mastoid process, which was followed by great diminution of the distressing noises in the ears.

(*e.*) RELAXATION OF THE FIBROUS LAMINÆ OF THE MEMBRANA TYMPANI.

Some writers have doubted the existence of the disease called "relaxation of the membrana tympani." Thus Dr. Kramer* says: "I may be allowed to banish relaxation and tension of the membrana tympani from the catalogue of diseases met with in practice, in which I have, indeed, been preceded by Itard, who, however, has not adduced his reasons." Although the writers who preceded Dr. Kramer, who had spoken of this disease, had not described the symptoms nor the appearances by which it could be recognised, they were nevertheless correct in stating that the disease in question existed. Indeed, it appears to me that no disease of the ear can be more distinctly diagnosed than the one under consideration.

The *causes* of this disease are:—1st, the effects of an ordinary cold, producing hypertrophy of the mucous layer; 2nd, inflammation of the fibrous layers. From either of these causes, the membrana tympani may lose its natural degree of resiliency and become flaccid, so as to fall inwards, and approach more nearly to the promontory than is natural; a change which ends in great dulness of hearing. This dulness may, however, be temporarily relieved by pressing out the drum to its natural position, either by swallowing with closed nostrils, by attempting a forcible expiration, or by forcibly and rapidly inhaling air through the nose. No sooner, however, is the act of swallowing in the natural way repeated, than the air escapes from the tympanic cavity, the membrana tympani falls inwards, and the dulness immediately returns. The *treatment* depends in a measure upon the cause of the affection. If the mucous membrane lining the tympanum be thickened, counter-irritation over the mastoid process should be practised; if the fibrous laminæ are inflamed, leeches should be applied to the margin of the meatus. Where the fibrous laminæ are weakened, a solution of the nitrate of silver applied to the outer surface of the membrane is frequently of great service. There are cases where the deafness is not in the least degree relieved by forcing air into the tympanic cavity: when this happens, it is most probable that partial

* On the Diseases of the Ear, translated by Bennett, p. 143.

anchylosis of the stapes has taken place. The following cases illustrate fully the symptoms and treatment of this disease.

Case I. *Membrana tympani relaxed; deafness temporarily diminished after filling the tympanic cavities with air.*—S. B., Esq., aged 18, consulted me in November, 1853, on account of a dulness of hearing.

History.—Several years previously, he became dull of hearing, without pain or any assignable cause, and lately the affection has so much increased, that he requires to be loudly spoken to within the distance of a yard. The deafness is greatly aggravated during a cold. The power of hearing is much improved whenever he has blown air into each tympanic cavity; but as soon as the act of deglutition is naturally performed, a sensation of weight is felt in the ears, and the deafness returns. On *examination* of the right ear, the membrana tympani was found to be opaque; its bright spot elongated; the form more concave externally than is natural. On swallowing, or forcing the air with the nose closed, the membrana tympani expands to its natural form, and remains so until the act of deglutition is repeated with the nose open, when it again falls inwards. Hearing distance with watch, half an inch. The left is in the same state as the right ear. The mucous membrane of the fauces is red and thick.

Treatment.—As there was an evident thickening of the membrana tympani, vesicating paper was applied behind each ear; the sixteenth of a grain of bichloride of mercury was administered every night; and a lotion was applied to the outer surface of each membrana tympani, consisting of three grains of nitrate of silver to an ounce of distilled water. This treatment, at the end of a fortnight, so greatly improved the patient's power of hearing, that he could distinctly hear an ordinary voice at three yards' distance. This improvement continued until the patient took a severe cold, when the deafness recurred; but was subdued again by a repetition of the treatment.

Case II. *Membrana tympani relaxed and congested; symptoms diminished temporarily by a forcible inspiration through the nose.*—J. J., Esq., aged 35, came to consult me in September, 1853.

History.—Since a child, has been subject to ear-ache in each ear. For a year or two, this pain has occurred in the right ear only, and has lately been very considerable. Complains of a

feeling of rumbling in the ears, and of so great a dulness of hearing that he has to be spoken to distinctly within the distance of a yard. The rumbling sensation and the deafness are both temporarily relieved by suddenly and forcibly drawing in the breath through the nostrils; but this improvement disappears immediately the act of swallowing is naturally performed, and if that act is delayed, the symptoms slowly return in the course of a few minutes. The patient has thus acquired the habit of incessantly "sniffing" the air, which is exceedingly unpleasant to himself and to every one around him. While sitting in my room, he must have performed this act twenty or thirty times. On *examination*, each membrana tympani was found red and dull, with the bright spot much larger than natural.

Treatment.—As there was palpable congestion of the membrana tympani, leeches were applied to the margin of the meatus; a vesicating paper kept on each mastoid process; and a warm solution of chloride of zinc (gr. ij. @ ℥j) was dropped into each meatus twice daily. By persevering in this plan of treatment for three months, the patient could hear nearly as well as was natural, and had completely lost the habit of "sniffing."

Case III. *Relaxation of membrana tympani from thickening of the tympanic mucous membrane, produced by a cold; deafness improved by forcing air into the tympanum, and by syringing with water.*—Miss J., aged 50, applied to me in May, 1853.

History.—Suffered when a child from disease of the left ear, which produced total deafness. For some years the left ear has been dull during a cold, and at times the deafness is very great; at present the patient has to be spoken to loudly within the distance of two yards; but after forcing air into the tympanum, the hearing is temporarily so improved that she can hear what is said in any part of an ordinary-sized room. This improvement can also be produced by syringing water; but under either treatment, the dulness of hearing speedily returns. In order to keep up a tolerable amount of hearing, she has fallen into the habit of blowing air into the ear every few minutes. On *examination* of the right ear, the hearing distance was found to be two inches. The membrana tympani was white, the surface shiny. Air entered through the Eustachian tube, and when it distended the tympanic cavity, the membrana tympani was

seen to move outwards to a much greater extent than natural. This movement was followed by a great improvement in the hearing, which, however, very soon disappeared.

Treatment.—Considering this to be a case of relaxation of the membrana tympani, produced by thickening of the tympanic mucous membrane, slight counter-irritation was excited over each mastoid process, and a solution of nitrate of silver (gr. iij @ ℥j) was dropped into each ear every night. Tonics were administered. After this treatment had been pursued for a fortnight, a manifest improvement took place, the patient heard better, and had no occasion to force air into the ear; the habit, too, has been nearly overcome. I have seen this patient once or twice since—once during the year 1855—and the result of the treatment has, on the whole, been satisfactory; the hearing remained much better, except during attacks of cold, when the old habit of "clearing the ears" by forcing air into them was had recourse to.

CHAPTER X.

THE MEMBRANA TYMPANI (*concluded*).

PERFORATION, CAUSES—PHYSIOLOGICAL OBSERVATIONS—EXPERIMENTS PREVIOUS TO THE FORMATION OF AN ARTIFICIAL MEMBRANA TYMPANI—ON THE ARTIFICIAL MEMBRANA TYMPANI—THE MODE OF APPLYING IT—CASES—RUPTURE OF THE MEMBRANA TYMPANI—PHYSIOLOGICAL OBSERVATIONS—PATHOLOGICAL OBSERVATIONS—CASES.

(*a.*) PERFORATION OF THE MEMBRANA TYMPANI, AND THE USE OF THE ARTIFICIAL MEMBRANE.

When speaking of ulceration of the fibrous layers of the membrana tympani, I had occasion to point out that perforation of the membrane itself sometimes, though rarely, takes place as a result. The usual cause of perforation of the membrana tympani is catarrh of the tympanic mucous membrane. In the latter case, a large quantity of mucous is excreted, which fills the tympanic cavity, and being too viscid or too abundant to escape through the Eustachian tube into the fauces, it consequently presses against the inner surface of the membrana tympani, causing gradual absorption of its substance, and ultimately perforation. That this affection is not the result of primary ulceration of the mucous membrane lining the inner part of the membrana tympani, is shown, I think, by the fact that in cases of perforation no appearances of ulceration are observable in any other parts of the tympanic cavity; indeed, as will be seen, when considering the diseases of the mucous membrane of the tympanum, ulceration is comparatively a rare occurrence.

The most usual cause of perforation of the membrana tympani is scarlet fever: in other cases it is connected with scrofulous disease, the mucous membrane of the tympanum throwing out

large quantities of mucus. The result of a perforation of the membrana tympani, as all medical men are aware, is a certain diminution of the hearing power. A small orifice, unattended with any other lesion of the organ, does not produce such a degree of deafness as to be very uncomfortable; but, if in addition to the small orifice, there is a thickened and relaxed condition of the mucous membrane of the tympanum, or of the remaining portion of the membrana tympani, then very serious diminution of the hearing power occurs. Even a large orifice in the membrana tympani often does not produce any serious amount of deafness; but if it is accompanied with much thickening of the mucous membrane of the tympanum, the patient is entirely debarred from conversation, except when specially addressed, in a loud tone, within the distance of a yard. What is the cause of deafness in cases of perforation? There is, it seems to me, no doubt but that one of the functions of the membrana tympani is to confine the sonorous undulations to the tympanic cavity, in order that they may be concentrated on the membrana fenestræ rotundæ. Indeed, it is probable that the vibrations only partially pass through the chain of bones to the vestibule, and that the air in the tympanic cavity is one great medium of communication with the labyrinth. If the means of communication with the labyrinth be the air in the tympanic cavity, it is palpable that an aperture in the membrana tympani is likely to diminish the power of hearing, by permitting the vibrations to escape from that cavity into the meatus, and so prevent their concentration upon the membrana fenestræ rotundæ. This explanation of the diminished power of hearing in cases of perforate membrana tympani, seems confirmed by the result of the treatment adopted for their amelioration.

Treatment.—Until very recently, the deafness arising from the presence of an aperture in the membrana tympani was regarded as incurable, and no systematic treatment was attempted, although several writers had alluded to the beneficial consequences following the introduction of foreign bodies, especially of lint and cotton wool, where there was perforate membrana tympani. Thus Itard cites a case in which the deafness was completely relieved by introducing a portion of cotton wool to the bottom of the meatus. Deleau, too, speaks of a patient

who greatly improved his hearing, using in this way a piece of wool or the central part of an onion. Mr. Tod describes "the relief derived from the mere introduction of a little lint into the external meatus in those cases where the membrana tympani has been ruptured or destroyed by disease. So great, indeed, is the improvement which takes place from the application of this simple remedy, that patients will frequently appear astonished at being so easily relieved."* In the year 1848, Mr. Yearsley published a pamphlet entitled "On a New Mode of Treating Deafness when attended by partial or entire Loss of the Membrana Tympani, associated or not with Discharge from the Ear." In this pamphlet he advocates the application of cotton wool in a moistened state, in cases of partial or entire loss of the membrana tympani; the object of this substance being, as he has subsequently stated, "to support the remaining portion of the membrana tympani, or the ossicula."† Respecting the mode of applying the wool, the following are his instructions: "A small piece of wool, differing in size according to the case, and fully moistened in water, is introduced through the speculum to the bottom of the meatus, and adjusted superiorly, inferiorly, anteriorly, or posteriorly, according to the situation of the perforation and other circumstances connected with the case; but care must be taken that the entire opening be not covered, otherwise the experiment will not succeed. It is also indispensable to success that the moisture of the wool should be preserved."

After having conducted some researches into the functions of the tympanic cavity, which were laid before the Royal Society, and made some experiments upon the ears of patients suffering from perforate membrana tympani, it appeared to me that an artificial membrana tympani could be constructed which might confine the vibrations to the tympanic cavity, and concentrate them upon the labyrinth. The course of investigation which had been pursued by me showed that the guttural orifice of the Eustachian tube is closed, except during the momentary action of certain muscles, and that for all purposes relating to the passage of sonorous undulations the tympanum is a shut cavity;

* Anatomy and Physiology of the Organ of Hearing. Pp. 105-6. 1852.

† Provincial Medical and Surgical Journal, August 18th, 1852.

and next, that by a modification of Mr. Wheatstone's experiment with a tuning fork, suggested to me by Mr. C. Brooke, the sonorous vibrations communicated to the bones of the head, appear much louder when the meatus externus is closed than when the orifice is open.

If, for instance, a tuning fork be made to vibrate, and then be placed in contact with the head, the sound proceeding from it will, in a few seconds, cease to be heard; but if directly on this cessation of sound, the experimenter close the entrance of the meatus in one ear so as to convert it into a shut cavity, he will instantly hear a renewal of the sound of the tuning fork; from which it appears most probable that the sonorous vibrations communicated to the external meatus impressed the membrana tympani much more powerfully when confined within the meatus than when allowed free communication with the external air. Considering the result of this experiment in connexion with the other fact of the ordinarily closed state of the tympanic cavity, it appeared to me highly probable that the sonorous vibrations imparted to the cavity of the tympanum, could only make their due impression on the membranes of the labyrinth when strictly confined to the tympanic cavity, and not allowed to expend themselves in the cavity of the fauces. This conclusion was strengthened by the fact, that all the walls of the tympanic cavity appear expressly constructed for producing resonance, having an investing membrane of so great tenuity as scarcely to be detected save by the touch or the use of a magnifying glass, and also by the observation, that this peculiar condition of the mucous membrane was restricted to the tympanic cavity itself and to that portion of the Eustachian tube which forms part of the resonant walls of that cavity.

If the view here advanced be correct, and if for the perfect performance of the function of hearing it be necessary to confine the sonorous vibrations to the tympanic cavity, it is clear that the analogy usually cited as existing between the kettle drum and the tympanum of the human ear, to the effect that in both the air within should be allowed to communicate with that without, is incorrect; and it is further evident, that an opening in the membrana tympani must more or less diminish the power of hearing. On examining patients affected with simple perforation of the membrana tympani, the impaired ability to

hear can, in fact, always be detected; although, as has been stated, if the orifice be small and the organ otherwise healthy, the difference is but slight. In the greater number of cases, however, where perforation of the membrana tympani exists, other lesions of a serious character have coexisted, such as thickening of the membrane of the tympanum, pressure on the membrane of the fenestra rotunda, derangement of the articulation of the stapes with the fenestra ovalis, or injury to the nervous expansion in the labyrinth. Under any of these circumstances it occurred to me, that as an orifice in the membrana tympani, by preventing the sonorous undulations, owing to their diffusion in the meatus, from being concentrated upon the membranes of the labyrinth, might be a direct cause of diminution of hearing power, so it was probable that increase of that power would follow an artificial closing of the orifice.

The preceding train of investigation led me to attempt the construction of an artificial membrana tympani, which, it was hoped, might serve as a substitute for the natural membrane, so far, at least, as its function of closing the tympanum, and thus rendering its walls resonant, was concerned.

These expectations of success were strengthened by the result of observations made by me on cases of perforate membrana tympani. When such cases are not complicated with any serious lesion of the organ, it must have been remarked by others as well as by myself, that the patient, from some apparently inexplicable cause, at times suddenly hears perfectly well, or nearly so. This return of the hearing sometimes remains for a few minutes only, at others, for one or more hours. Having found the improvement to follow the use of a syringe and tepid water, or even of the handkerchief, I examined the ear in certain patients after these operations were finished, and found that in the former case a bubble of water, in the latter, of discharge, had filled up the orifice in the membrana tympani. On destroying the bubble, the improvement in the hearing at once disappeared. In one patient its stay could be prolonged by the use from time to time of a solution of gum acacia in water. On reconsidering these facts, since the completion of my observations upon the closed state of the tympanic cavity, I have arrived at the conviction that the bubble of water, discharge, or mucilage, acted beneficially by temporarily reconfining the

sonorous undulations to the tympanum, a conviction which subsequent observations have strengthened.

After some experiments, I tried vulcanized India-rubber and gutta-percha, making use of the thinnest layers of them that were procurable. With both these substances I succeeded in making a rude kind of artificial membrana tympani, by cutting a portion about the size of the natural membrane, and passing through it a piece of thread, by means of which it could be conducted through a fine tube to its proper situation. The tube was then withdrawn, and the thread left in the meatus, so that the patient, or the operator, could remove the artificial membrane at pleasure. The disadvantages of this apparatus were—difficulty of applying it on the part of the patient; liability of the material to be torn by the thread; and the unsightliness of the latter hanging down from the meatus. The experiment, however, was so far satisfactory as to induce me to request Messrs. Weiss to construct one, the centre of which should consist of two very fine plates of silver, having a diameter of about three-quarters of a line, between which the layer of vulcanized india-rubber, or gutta-percha, might be placed, and having a silver wire attached to the surface of the outermost plate. The artificial membrana tympani, made by Messrs. Weiss from these directions, has hitherto been perfectly successful. As supplied by them, the portion of vulcanized india-rubber (the only material now used), is about three quarters of an inch in diameter, which leaves ample margin for the surgeon to cut out a membrane of any shape that may seem to him desirable; and to leave the silver plate either in the centre or towards the circumference at his discretion. The silver wire is of suffi-

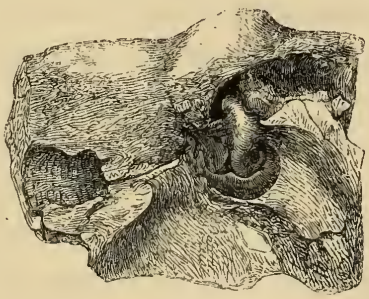
THE ARTIFICIAL MEMBRANA TYMPANI.

cient length to admit of the membrane being introduced or withdrawn by the patient, but is not perceivable externally, except by special observation. A pair of forceps is made, by which the artificial membrane can be more easily introduced or withdrawn.

Before describing the method of applying the artificial membrana tympani, a few words are required respecting the state of the remaining portion of the membrana tympani, after perforation has taken place. The orifice is, in some cases, not larger than a pin's head; in others, a line in diameter; while in many the entire membrane is destroyed, with the exception of a margin at the circumference, about half a line in diameter, which being composed of the combined fibres of the thickest portion of the circular and radiate laminæ, generally remains.

MARGIN OF THE CIRCUMFERENCE OF THE MEMBRANA TYMPANI REMAINING AFTER THE DESTRUCTION OF THE REST OF THE MEMBRANE.

This margin is deepest at the upper part. In rare cases, the long process of the malleus continues entire, after the complete destruction of the membrane to which it was attached; but, as



HANDLE OF THE MALLEUS REMAINING AFTER THE DESTRUCTION OF THE MEMBRANA TYMPANI.

a general rule, the whole of this process is gradually absorbed, leaving merely the head of the bone (which articulates with the incus), the neck, and the body, which receives the attachment of

the tensor tympani ligament internally. Anteriorly and posteriorly the fibres of the remnant of the membrane are attached; and externally the processus brevis remains. It will, therefore, be understood, that in cases of so-called destruction of the membrana tympani, a margin is generally left, to which the body of the malleus remains fixed, and to the inner part of this the tensor tympani ligament and muscle are attached; affording the means by which the small bones and muscles of the tympanum are still enabled to perform their functions. In cases of general ulceration of the mucous mem-

BODY OF MALLEUS REMAINING AFTER DESTRUCTION OF MEMBRANA TYMPANI.

brane of the tympanum, which fortunately seldom occurs, the incus is commonly discharged, and sometimes the malleus also; but even in these cases, if the attachments of the stapes to the circumference of the fenestra ovalis remain uninjured, the power of hearing may be greatly improved: should the stapes, however, be removed, total and irremediable deafness ensues.

The artificial membrana tympani is of the greatest benefit in those cases where there is a well-defined aperture in the natural membrane, or, if that membrane be entirely absent, where there is simple hypertrophy of the mucous membrane of the tympanum, with or without discharge from its surface. In these cases, the organ will be found to have by no means entirely lost its power of discerning sounds; for, as a general rule, the human voice is heard when the speaker's mouth is brought within a foot of the patient's ear, and the speech is slow and distinct. This diminished power of hearing entirely excludes

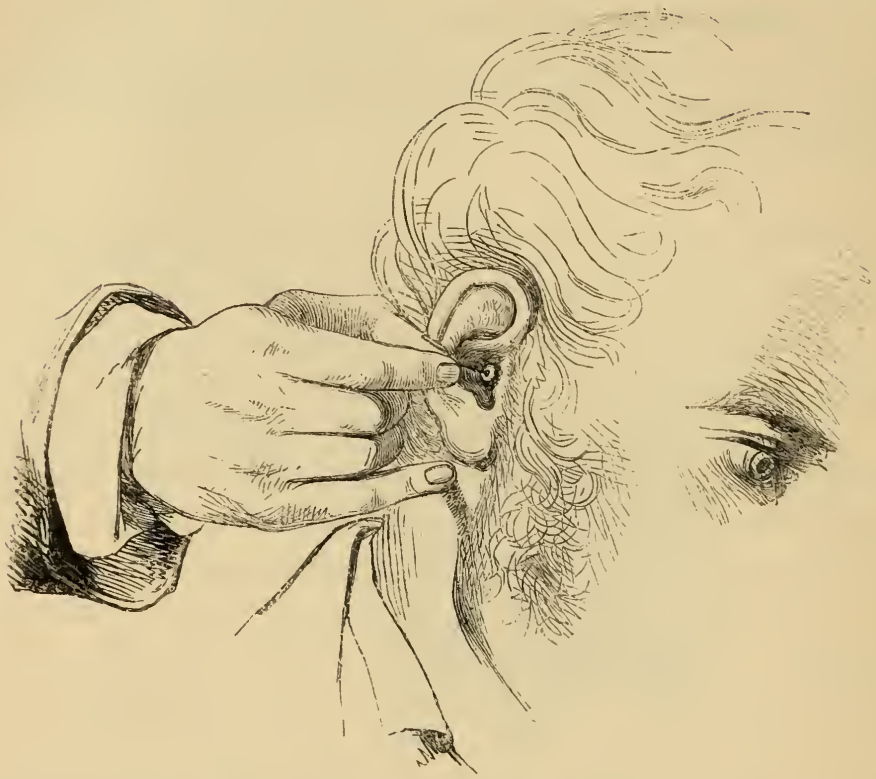
the sufferer from the advantages of general conversation; but the deafness is greatly aggravated when to the affection of the membrana tympani and mucous membrane of the tympanum is added anchylosis of the stapes to the fenestra ovalis, or when the nervous expansions have been injured. In such cases, the patients have to be shouted to close to the ear, and the artificial membrane is useless.

THE MODE OF APPLYING THE ARTIFICIAL MEMBRANA TYMPANI.

As in cases of perforation or destruction of the membrana tympani, there is so frequently catarrhal inflammation of the mucous membrane of the tympanum, it is obviously important that no foreign substance should be placed in contact with that membrane; and as there is always a margin of the membrana tympani remaining, the surgeon should be careful to keep the artificial membrane external to it. After accurately noting the size of the inner extremity of the meatus to which the natural membrane was attached, the operator should proceed to cut the artificial membrane as nearly of the size and shape of the natural one as possible, taking care at the same time to keep the margin quite smooth and regular.* The patient should then be placed with the head inclined to the opposite shoulder, while a strong light is thrown into the meatus, which, if liable to discharge, should have been previously syringed. The operator will next take the artificial membrane, and having moistened it with warm water, pass it, by means of the silver wire, gently inwards until it has reached what he considers the natural position. This he will ascertain by the occurrence of a faint bubbling sound, caused by the escape of the slightly compressed air beyond it; he will also feel a slight obstruction offered to its further passage by the remnant of the natural membrane. Should any attempt be made to pass the artificial membrane beyond this point, the patient will complain of pain, which up till then had not been felt. The most certain test, however, of the proper placing of the artificial membrane, is the sensation of the patient, who discovers, by the sound of his own voice, or

* In cases where only a small border of the natural membrane remains, it is often desirable to cut the artificial membrane of a size larger than the inner extremity of the tube, so that the edge may turn outwards.

that of the surgeon, or by the movement of his tongue and lips, that his hearing has been suddenly improved.



SURGEON INTRODUCING THE ARTIFICIAL MEMBRANA TYMPANI.

As will be imagined, great care must be taken to cut the membrane so that it shall fit the inner extremity of the meatus with exactness; since if too large, it would cause discomfort, and if too small, it would not fulfil its purpose, of rendering the tympanum an airtight cavity. It is not easy, in all cases, to fit the artificial membrane, so as not to allow of any communication between the air in the tympanum, and that in the external meatus; this, however, is the object which should always be aimed at. The patient, at first, should be told not to use the artificial membrane for more than two hours daily; and if any uncomfortable feeling is experienced, one hour, or even half an hour, will be sufficient.

It might, perhaps, be expected, that the contact of a foreign body, like the artificial membrana tympani, with the walls of the external meatus, would soon become intolerable; such, however, is not the case; several patients have left my room without being able to say, from the sensation in the ear, whether any

foreign body were there; and many have now worn this apparatus daily, during several years, without suffering the least pain. The explanation of this circumstance may be found in the fact, that the most sensitive part of the meatus externus is about its centre, while the membrane in the immediate vicinity of the membrana tympani is less abundantly furnished with nerves: to this may be added, that the circumference of the artificial membrane presses with extreme gentleness against the wall of the meatus.

The results of the application of the artificial membrane have been more satisfactory than there was reason to anticipate. I have already used it beneficially in many hundreds of cases. The substitution of a thin layer of vulcanized india-rubber for so exquisitely delicate a structure as the healthy membrana tympani, would be expected to afford but trifling aid; yet such is not the case; for among the patients relieved by it, most have heard the human voice perfectly across an ordinary sized room, and in one case, the voices of boys in the open air, were heard at a distance of between one and two fields. Surgeons who have paid careful attention to diseases of the ear, will not be surprised at the efficient substitute the artificial membrane offers, as they will call to mind many cases in which the natural organ has been greatly hypertrophied, especially in chronic inflammation of its dermoid layer, with but a very slight diminution of the power of hearing.

The surgeon having ascertained that the artificial membrane is beneficial to the patient, it may be allowed to remain in the ear for a few hours, and the time gradually increased to a whole day. It is often desirable, that the use of the membrane should be preceded or accompanied by vesication over the mastoid process, whereby the thick mucous membrane of the tympanum may be rendered more healthy. In all cases, the artificial membrane should be removed at night, and when there is any discharge, the ear should be syringed night and morning with tepid water.

Case I. *Deafness for sixteen years; discharge from each ear for six years; aperture in each membrana tympani; power of hearing restored.*—Peter Turnbull, aged 43, formerly in the army, from which he was discharged on account of deafness, was admitted under my care, at St. Mary's Hospital, on the

12th January, 1852. He stated that sixteen years ago, without any other assignable cause than a cold, he became slowly dull of hearing, and five or six years ago, a discharge issued from both ears, which has continued to the present time. The power of hearing has been gradually declining, so that at present he must be loudly addressed close to his head. On *examination*, an aperture, between one and two lines in diameter, was observed in each membrana tympani, and the mucous membrane of the tympanum, which was the source of the discharge, was thicker and redder than natural.

The *treatment* consisted in keeping up counter-irritation over each mastoid process, and in the use of an injection composed of three grains of acetate of zinc to an ounce of water; and under this he somewhat improved, though the hearing still remained so defective, that he was precluded from following any avocation. In the commencement of June I experimented on this patient with the first artificial membrana tympani, composed of vulcanized india-rubber, and the good effect was at once decided. When it was placed over the surface of the original membrane, so as wholly to close the orifice, the patient made a movement of his lips, and said, "I hear as differently as possible from what I have done for many years; everything sounds clear!" This patient went away with the artificial membrane in his ear, hearing conversation perfectly. The following morning he came to my house, saying, that he had accidentally moved what I had left in his ear, and that "he was as dull as ever." I replaced the artificial membrane, and he again heard well; and being supplied with one which he could introduce or remove at pleasure, he has worn it during the day ever since, and has never complained of pain or discomfort from it. Latterly, his hearing has so greatly improved, that he has been able to dispense with the use of the artificial membrane for a few hours daily, but he hears much better with than without it. As a proof of the great amelioration that has taken place, this patient told me, that one day, while in the country, and using the membrane, he heard voices at a distance, and upon going to the place whence they appeared to proceed, he found some boys under a hedge, more than a field distant from the spot where he heard them. He is going back into the army.

This patient was shown at a meeting of the Pathological

Society of London, in February, 1853. The following is the published report:—"The artificial membrane having been removed, the members of the Society had the opportunity of observing the perforate condition of each membrana tympani. After the removal of the membranes, he could not hear, unless loudly spoken to; but when he had replaced them, which he did with apparent readiness, his hearing was excellent."

Case II. *Each membrana tympani destroyed by measles, at four years of age; hearing restored by the artificial membrane; great sensibility to sounds.*—Miss B., aged 21, consulted me on November 9, 1853, on the recommendation of Dr. Grindrod, of Seaforth, near Liverpool. The health was good.

History.—At four years of age, she suffered from an attack of measles, which was followed by discharge from the ears, lasting to the present time; so that the ears require syringing every day. Since the measles, the power of hearing so greatly deteriorated, that she has to be distinctly spoken to within the distance of a yard. On inspection, it was found that the membrana tympani of each ear had been destroyed, and that the only vestige of it left was a very narrow margin. The mucous membrane lining the tympanic cavities was very red, much thicker than natural, and covered with a mucous discharge.

Treatment.—An artificial membrana tympani was introduced into each ear, the immediate effect of which was to improve the power of hearing so greatly, that the patient heard my voice perfectly well across my room with my back towards her. Ordered to wear the artificial membranes during the day, to take them out at night, and to syringe the ears with warm water twice daily.

13th.—Has been wearing the membranes every alternate day, and has heard perfectly while they were worn; indeed, the only drawback to her comfort has been, that her friends still speak loudly to her, which causes considerable uneasiness in the ears from the very great sound.

16th.—Continues to hear well; but has been obliged to remove to a quiet street, as the sound of carriages passing the house has been annoying. She complains of the "intolerable rustling of her silk dress," of which she was never before conscious. The patient left London after some further watching, quite comfortably. I received a letter from her in the following December, from which I subjoin an extract.

"I am thankful to say, the improvement in my hearing has increased almost daily, and I now hear general conversation easily, and feel quite a different person from what I did a short time since. I am still sensitive to sounds, but not nearly so much distressed with them as I was at first. I found the noise of the organ at church too great the first time I went, and came out almost as soon as the service commenced. I find no pain in my ears, and am, in all respects, in the enjoyment of good health."

Case III. *Deafness of twenty years' duration, perfectly relieved by the artificial membrane.*—The following particulars of a case, concerning which we corresponded, were sent to me by Dr. Shearman, of Sheffield:—"I tried the false drum in one ear; the whole of the membrana tympani had been destroyed, and the cavity of the tympanum so bared to the view, that it was difficult at first to ascertain whether the drum membrane had gone, or was obscured by polypoid or other growths; however the probe came down upon the bone. The false drum gave such relief, that the hearing distance was increased from actual contact to twelve, and subsequently to eighteen inches: the patient is now able to manage the contrivance herself.

"The other membrana tympani of the same patient is yet so covered with polypous growths, that I cannot make out the precise condition of the drum; however, inflation of the tympanum shows that the membrana tympani is perforated. The deafness in this case is of nearly twenty years' duration, is perfectly removed on the left side, and although the whole of the left membrana tympani is destroyed, the false one acts perfectly."

Case IV. *Destruction of each membrana tympani: stricture of the meatus.*—Miss S., aged 24, not in very good health, states, that at four years of age, she suffered from an attack of scarlet fever, subsequently to which she became so hard of hearing, as to need to be distinctly spoken to within the distance of a yard. This hardness of hearing is increased during cold and damp weather; has had discharge from both ears, but at present it is only very slight from the left, which is the better ear. Complains of no pain, but of a noise. Lately, from not being in good health, the hearing has been more than usually dull.

Examination.—Right Ear.—Hearing distance of watch, half an inch. The central part of the meatus is contracted to less than half its natural size. A very strong light having been

thrown beyond the contracted portion, part of the mucous membrane of the tympanum could be detected; but there was no appearance of the membrana tympani.

Left Ear.—Hearing distance, one inch: meatus contracted as in right ear; the membrana tympani was not seen, but in its place the shining tympanic mucous membrane was observed.

At first sight it appeared as if the presence of the stricture would offer an obstacle to the introduction of the artificial membrane. I nevertheless tried a small one to each ear, passing it through the stricture, and then moving it gently to and fro, so as to allow it to recover its plane surface. Having done this, I moved it slightly forwards to the situation of the natural membrane, and immediately, the patient heard perfectly all that was said at any part of the room. There was little difference between the hearing power of the two ears. Care was required in the management of the case, from a slight tendency to irritation of the meatus; but the patient left me hearing well. In the middle of February, 1854, the mother of this lady being in London, called to thank me for the benefit produced in her daughter's case. She said that her daughter "continued to hear perfectly, and that she was quite an altered person."

Case V. *Deafness from scarlet fever during five years. Hearing completely restored by the use of the artificial membrane.*—Miss G., aged 14, was brought to me, in August, 1853, by Dr. Grindrod. Health good.

History.—When between nine and ten years of age, suffered from scarlet fever, since which time, has had a discharge from both ears, attended by such a decline of the hearing, as to require her to be loudly spoken to very near. She has lately been to a school at Brussels, where her defective hearing had greatly hindered her progress. On inspection, it was found that the membrana tympani of each ear was absent, while the mucous membrane of the tympanum was thick and red, and poured out a mucous secretion. An artificial membrana tympani was applied to each ear, and produced so complete a restoration of the hearing power, that the patient could detect all that was said in different parts of a large room. This patient returned to school at Brussels, and in about six weeks afterwards, I received a letter from the father, a medical man, from which the following is an extract:—

"We have had the most pleasing intelligence from my little

daughter, at Brussels, respecting her hearing. I think I cannot do better than give it in her own words:—'I have had three German doctors, and one French one, to see me, or rather the artificial membrane. I am quite a new creature, my hearing is so greatly improved.'" The father adds, "This is very satisfactory evidence as to the successful operation of your beautiful invention, after nearly five years' deafness to the extent, that she was unable to hear a word in church the whole of the time."

Case V. *Deafness for twenty years, from measles and scarlet fever, greatly improved by the artificial membrane.*—Mr. M., aged 23, consulted me 20th December, 1853. Health good. No relatives deaf.

History. — At three years of age had scarlet fever and measles at the same time, accompanied by much discharge from each ear; was totally deaf for some months after the attack, but slowly improved, so as to hear a loud voice spoken near the left ear; the right ear nearly useless; lately has heard better at times with the left ear for two or three hours. To-day requires to be spoken to loudly within two feet of the left ear, and is about the same as usual. On *examination* of the right ear, the meatus was found to contain a collection of mucus and epidermis, which being removed, the membrana tympani was seen to be white as paper, flat and thick: posterior to the inferior third of the malleus is a small orifice, about three quarters of a line in diameter, through which mucus oozes from the tympanic cavity. Watch not heard even when pressed against the ear; but the crack of the nails was distinguishable.

Left Ear.—The meatus contained a shreddy discharge; the membrana tympani was absent; the mucous membrane of the tympanum red and much tumefied. Watch heard when in contact with the ear. Although the hearing power of the left ear was somewhat less than in the majority of cases where there is an absence of the membrana tympani uncomplicated with any other disease, I, nevertheless, determined to try the artificial membrana tympani, the effect of which was to improve the hearing considerably, although not to the same extent as in the majority of cases.

Dec. 21st.—Ordered to wear the membrane for four hours.

22nd.—Upon using the membrane to-day, heard my voice distinctly half across my room.

27th.—Says that he never remembers to have heard so well as yesterday; heard everything that was said at dinner, and his own voice quite distinctly: the sound of the rustling of a lady's silk dress quite astonished him. Towards the latter part of the day did not hear quite so well; and last night, after removing the drum, was exposed to cold, which caused some pain. Without the drum to-day could not hear my voice, unless I spoke into his left ear; with it, heard much better, but not so well as yesterday, which arose from the mucous membrane of the tympanum being much tumefied. This tumefaction gradually subsided, and the patient left me a few days afterwards, hearing quite well. He inserts the artificial membrane himself, which requires some care in its adjustment. On one occasion, when he started for a walk in the street, after having inserted the membrane, his hearing was far from good; but as he walked on the pavement, a sudden movement took place in the ear, and he heard perfectly.

In a letter of February, 1854, this gentleman says: "I have much pleasure in informing you that the artificial membrane continues to be effectual; my friends are much gratified at the improvement you have been able to effect."

(*b*) RUPTURE OF THE MEMBRANA TYMPANI.

Previous to speaking of this affection, it seems to me desirable to make some remarks upon the functions of the membrana tympani and chain of ossicles.

I. *The Articulation of the Stapes.*—The stapes is generally described by anatomists as being connected with the margin of the fenestra ovalis by a simple membrane. Sir Anthony Carlisle, in his paper on the Physiology of the Stapes, merely speaks of "a membrane which connects it to the edges of the fenestra vestibuli."* Professors Sharpey and Quain agree with Sir A. Carlisle. They say, "The annular ligament of the stapes connects the base to the margins of the foramen fenestra ovalis. The fibres of the ligament are covered, on the outer side by the mucous lining of the tympanum, and on the inner side by the membrane of the vestibule."† Mr. Wharton Jones describes

* Philosophical Transactions, p. 201. 1805.

† Elementary Anatomy, p. 940. 1848.

this ligament as springing "from the margin of the vestibular fenestra, and it is inserted into the jutting margin of the base of the stapes all round."* Sœmmering seems to have had a different view respecting this articulation. He says, "A thin articular capsule connects the base of the stapes to the fenestra ovalis."†

If the circumference of the base of the stapes be carefully examined by means of a lens magnifying between three and four diameters, it will be apparent that, instead of a fine margin only, it presents a distinct surface which, when *in situ*, looks towards the border of the fenestra ovalis, and is separated from the inner and outer faces of the base by well-defined margins. The circumferential surface of the base varies in breadth: the broadest part has its surface inclined obliquely backwards and outwards; measures about a third of a line at its centre; and gradually narrows as it becomes continuous with the superior and inferior surfaces. The anterior extremity of the surface is not so broad as the posterior, and, instead of being oblique, is slightly rounded. The upper and lower surfaces of the base of the stapes are narrower than either the anterior or posterior portions, and their middle part is the narrowest. When examined in a recent ear the circumferential surface of the base of the stapes is found to be quite smooth, and covered by a very delicate layer of cartilage, which, when touched by a fine probe, communicates a soft sensation to the finger. This cartilage consists of oval corpuscles, very like these in ordinary articular cartilage, though much smaller, and is most abundant at the two extremities, from which portions can often be removed, especially in young persons, for examination by the microscope. The surface of the fenestra ovalis to which the circumferential base of the stapes is applied, is larger than that of the stapes; nor does its posterior surface quite correspond in direction with that of the stapes, but looks directly forwards, instead of obliquely inwards and forwards, to face the stapes, which, as stated, inclines backwards and outwards. The articulating surface of the fenestra ovalis is smooth, very compact in appearance,

* Cyclopædia of Anatomy and Physiology, vol. ii. p. 548.

† De Corporis Humani Fabrica, tomus secundus, de Ligamentis Ossium, p. 10. Huschke states, that Sœmmering was wrong in regarding this ligament as a capsule. Huschke speaks of the ligamentum annulare only.

seems to have no cartilage upon it, and is bounded by two well-defined ridges. The circumference of the base of the stapes is attached to that of the fenestra ovalis by means of two membranes or ligaments. The inner, or vestibular ligament, passes from the inner margin of the fenestra ovalis to the inner margin of the circumference of the base of the stapes; and the outer ligament passes from the outer margin of the one to the outer margin of the other. These two ligaments have between them a space which may be called the articular cavity, as it contains enough fluid to lubricate the articulating surfaces of the bones. By the action of the tensor tympani muscle, the base of the stapes is pressed inwards towards the vestibule, as a piston in its cylinder; and as soon as the muscle ceases to act, the ligaments just described, being elastic, draw the base of the stapes out again.

II. *Movements of the Stapes.*—The stapes is moved by two muscles, the tensor tympani and the stapedius. Anatomists seem agreed that the action of the tensor tympani is to press the stapes directly inwards towards the cavity of the vestibule, and the general opinion appears to be that the stapedius muscle merely assists the tensor tympani. Thus Mr. Wharton Jones says: "The first action of this muscle (the stapedius) will be to press the posterior part of the base of the stapes against the vestibular fenestra. At the same time, the long branch of the incus will be drawn backwards and inwards; and the head of the malleus being, by this movement of the incus, pressed forwards and outwards, its handle will be carried inwards, and the membrana tympani thus put on the stretch. Breschet calls the muscle of the stapes a laxator, but I do not know on what grounds."* Professors Todd and Bowman write: "In contraction it (the stapedius muscle) would fix the stapes by pulling its neck backwards. It probably compresses the contents of the vestibule."† Ellis states that "it assists in retaining the stapes applied to the fenestra ovalis."‡ Müller writes: "The influence of the stapedius muscle in hearing is unknown. . . . The only effect which it appears to me could be ascribed to it, would be to render tense the membrane by which the base of the stapes is connected with the margin of the fenestra."§

* Cyclopædia of Anatomy, vol. ii. p. 549.

† Physiological Anatomy, 1847. Part III. p. 71.

‡ Demonstrations of Anatomy, p. 286.

§ Elements of Physiology, by Baly, vol. ii. p. 1264, 1842.

On account of the smallness of the stapedius muscle, and the very slight degree of movement it produces, there is difficulty in determining in what way that muscle influences the contents of the vestibule. As the tendon of the stapedius, in its course forwards, passes slightly upwards, there is good reason to infer that it draws the neck of the stapes backwards and slightly downwards, and that it produces a slight rotation of the base. That this rotatory movement of the stapes has the effect of somewhat withdrawing its base from the cavity of the vestibule is, I think, shown by the following experiment. The tympanic cavity and stapedius muscle being exposed, and the stapes left *in situ*, by means of a small pair of cutting forceps a section is to be made through the cochlea, a portion of which should be left in connexion with the vestibule. The scala vestibuli of this portion will be seen filled with fluid as far as the margin of the section; and this fluid is of course continuous with the perilymph in the cavity of the vestibule. If the stapedius muscle be now pulled, or if the neck of the stapes be gently moved backward, the fluid in the exposed sac of the scala vestibuli will be observed to recede slightly into the scala vestibuli, and its surface to become concave; as soon, however, as the stapes is allowed to return to its quiescent state, the fluid repasses into and fills the scala vestibuli, assuming a rounded surface. Independently of thus acting on the contents of the vestibule, the stapedius muscle produces a slight relaxation of the membrana tympani. This is effected by the neck of the stapes, in the act of rotation, passing outwards as well as backwards, and thus gently pressing outwards the inferior extremity of the incus; so that the body of the latter bone passes inwards, carrying with it the head of the malleus, and necessitating the long process of the latter bone and the membrana tympani to pass outwards. It would therefore appear that the stapedius muscle acts as the direct antagonist of the tensor tympani muscle; the former relaxing the labyrinthine fluid, the membrana fenestræ rotundæ, and the membrana tympani; and the latter rendering tense the labyrinthine fluid and the two membranes. This view is supported by the fact that the stapedius muscle is supplied by a branch from the portio dura nerve, and the tensor tympani from the otic ganglion.* It seems to me fair, therefore, to infer that the function

* In addition to the above description, I may draw attention to a mono-

of the tensor tympani muscle is to protect the membrana tympani and the labyrinth from injury by loud sounds, while the stapedius muscle places these structures in a condition to be impressed by the most delicate vibrations; and it would appear to be brought into action during the process of listening. Instances are not uncommon in which these two muscles are unable to act promptly, and the unpleasant consequences are manifest. Thus the loud noise produced by suddenly and unexpectedly firing a cannon near a person, by not permitting the tensor tympani to contract in time, causes frequently a sensation of singing or buzzing in the ears, produced most probably by a concussion of the expansion of the auditory nerve: sensations which sometimes endure for many years. Cases are not unfrequent in which the mucous membrane of the tympanum is thickened, and a great amount of dulness of hearing is the consequence. Many patients thus affected hear sounds (the human voice for instance) perfectly well when they are listening; but as soon as the act of volition is suspended, the same voice in the same position is not perceived. In these cases it would appear as if the stapedius muscle had to counteract the pressure upon the stapes, by the thick mucous membrane. The friends of young persons suffering in this manner, often imagine that there is no real dulness of hearing, but simply a want of attention;

graph on the ear by Huschke, before alluded to, in which he has arrived at similar conclusions respecting the functions of the stapedius muscle to those just advanced. As it is evident, from the quotations from writers on the ear previously cited, that those views have not been entertained, I have not scrupled to give my researches at length. The following are Huschke's words: "While it (the stapedius muscle) presses the posterior extremity of the base of the stapes upon the posterior part of the border of the fenestra ovalis, it lifts the anterior extremity of this bone and covers the fenestra. At the same time, the descending branch of the incus, with the stapes, is drawn backwards, by which the body of this bone presses the malleus forwards, and, as its handle rests upon the membrana tympani, it relaxes it. I have often observed this movement of the malleus when I moved the long branch of the incus in the direction of the tendon of the muscle of the stapes. I thus regard the latter as relaxing the tympanum and opening the labyrinth; that is to say, according to the view of Treviranus, it is the antagonist of the tensor tympani muscles. The two have altogether much analogy: they describe an arch looking upwards, pass over a kind of pulley, and are contained in an osseous canal; but they have also opposite functions: the stapedius muscle passes from behind forwards; the tensor tympani from before backwards; the stapedius receives its nerve from the facial, the tensor tympani from the fifth."—*Encyclopédie Anatomique*, tome v., pp. 782, 783.

the fact being that the power of hearing certain sounds has ceased to be involuntary with these patients, and can only be exercised by a strong effort of the will.

The tensor tympani muscle appears to be of use not merely in preventing the membrana tympani and labyrinth from being injured by powerful sonorous vibrations, but also in protecting these organs from the forcible pressure of air or of a foreign body. Thus the membrana tympani offers considerable resistance to the pressure of a foreign substance which has been slowly introduced into the meatus; though the sudden and unexpected contact of a similar body often produces extensive laceration of it. Again, a violent blow on the ear with the palm of the hand, rarely produces mischief to the membrana tympani when its reception is expected; whereas a comparatively gentle but unexpected blow, frequently produces not merely concussion of the nervous labyrinth and serious derangement of its functions, but not uncommonly ruptures the membrana tympani itself.*

The preceding observations indicate that one function at least of the ossicles and muscles of the tympanum and the membrana tympani, is to act as the analogue of the iris in the eye, and to regulate the amount of sonorous undulations that are to pass to the labyrinth. This view has already, to a certain extent, been alluded to by previous writers. M. Savart, in the course of his very interesting researches upon the functions of the membrana tympani, arrived at a somewhat similar opinion; although he omitted to point out the manner in which the muscles acted on the labyrinth and membrana tympani. He says: "Les osselets ont encore pour fonction de modifier l'amplitude des excursions des parties vibrantes des organes contenus dans le labyrinthe."† Mr. C. Brooke, in a Lecture delivered at the Royal Institution, in the year 1843, says: "This osseous arrangement may be considered to perform an office in the ear analogous to that of the iris in regard to light; namely, that of regulating the tension

* I may mention a case illustrative of the above statement. The first that of an eminent physician in London, who, while playing with his children, received a blow on one ear from the head of one of them coming suddenly and rapidly into contact with it: from that time to the present (an interval of four to five years), there has been a constant singing in that ear.

† Récherches sur les Usages de la Membrane du Tympan et de l'Oreille externe, par M. Felix Savart. Lu à l'Académie Royale des Sciences le 29 Avril, 1822. Journal de Physiologie, par F. Majendie, tome iv. p. 183.

of the various structures that are thrown into a state of vibration, according to the pitch and intensity of the sound to be transmitted to the sentient nervous fibres. This is effected by the conjoined action of the tensor tympani and stapedius muscles, by which the tympanum would be rendered more tense, and a simultaneous change in the position of the stapes would alter the tension of the fluid throughout the labyrinth, and therefore also the tension of the membrane of the fenestra rotunda, which intervenes between that fluid and the air in the tympanic cavity."* Professors Todd and Bowman state that there is "much reason to suppose that the tensor tympani muscle is analogous in its use to the iris, and destined to protect the organ from too strong impressions."†

The first effect of the destruction of the membrana tympani gives weight to the opinion here advocated. Mr. Busk has detailed to me the particulars of a case in which, for a few days after the destruction of the membrana tympani, a patient was unable to endure the whistling of another in an adjoining bed; and Cheselden says, "that after destroying the tympanum in both ears of a dog, for some time it received strong sounds with great horror."‡

Pathological observations.—There are several modes in which the membrana tympani may be ruptured. The most common is an unexpected blow on the ear. It may also be ruptured by having a foreign body forced through it; by very loud sounds; by a fall; by violently blowing the nose; or by vomiting. Mr. Wilde relates a case in which the membrana tympani was ruptured by a gentleman, while bathing, thrusting his little finger into the meatus to dislodge some water.

In cases of simple rupture, as from an unexpected blow on the ear, the margins of the orifice are usually in contact, scarcely any hæmorrhage occurs, fibrin is effused, and the rent is speedily repaired. Where, however, the margins of the membrane are no longer in contact, and where the membrane has been much strained, very great irritation may ensue, requiring active anti-inflammatory measures. The most serious cases arise from the injury inflicted by the introduction of a foreign body, since the dermoid layer usually participates in the disease.

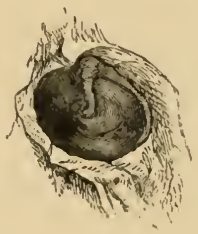
* Lancet, 1843, p. 380. † Physiological Anatomy, Part III. p. 91.

‡ The Anatomy of the Human Body (5th edition), 1740, p. 305.

In cases of simple rupture of the membrana tympani where inflammatory symptoms are still present, it is not desirable to do more than introduce a portion of cotton wool into the meatus, to prevent loud sounds from acting injuriously upon the drum. Where the inflammation is great, leeches must be applied below the ear, and to the margin of the orifice of the meatus, and evaporating lotions used to the margin of the meatus itself. Should these remedies be unsuccessful, counter-irritation must be applied over the mastoid process.

Case I. *Membrana tympani ruptured by an unexpected box on the ear.*—Master G., aged 14, was brought to me on June 2, 1852, on account of a peculiar sensation in the left ear whenever he blew his nose.

History.—Five days ago, as he was sitting still, his tutor came quietly behind him, and suddenly and unexpectedly gave him a gentle box on the left ear, which produced instantaneous pain deep in that organ. On using his pocket-handkerchief afterwards, he experienced a tingling and clicking in the ear, in which he has since also had pain at times, and from which occasionally a drop or two of blood have escaped. Inspection showed a small orifice at the lower part of the membrana tympani, about a line in diameter, with white borders. Air passed through on holding



AN APERTURE IN THE LOWER PART OF THE LEFT MEMBRANA TYMPANI, FROM RUPTURE.

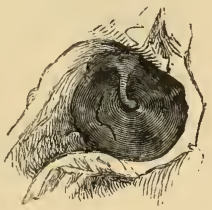
the nose and blowing gently. The watch was heard at the distance of a foot. As there was some slight pain, a leech was ordered to be applied below the ear every second night. This was continued for ten days, at the end of which time the pain had disappeared, the orifice had closed, and the hearing power had returned.

Case II. *Rupture of the membrana tympani by a blow on the ear with a bolster.*—Master K., aged 14, was seen by me in con-

sultation with Mr. Keal, on December 20, 1855, on account of an unpleasant sensation in the left ear.

History.—A week ago was engaged in a "bolstering match" at school, during which he received a blow with a bolster on the left ear, which caused him pain. In the morning, on using his pocket-handkerchief, he found that air rushed out of the left ear, so that he was obliged to place his finger upon the ear while using the handkerchief. On examining the ear, a rent was observed in the membrana tympani, running from the lower extremity of the malleus downwards to the inferior parts of the membrane. The margins of the rent were in contact, but the air passed through with the slightest pressure from the fauces. The hearing power was natural. He was ordered a little evaporating lotion to apply on cotton to the orifice of the meatus. Twelve days afterwards the margins of the orifice were observed to be swollen, and a small coagulum of blood attached to them: air passed into the tympanum from the fauces, but it did not escape through the aperture. When I saw this patient after another fortnight, the orifice was closed, but the cicatrix remained.

Case III. *Membrani tympani ruptured by blowing the nose forcibly.*—Miss S. A. N., aged 16, consulted me on February 5, 1850, for pain and discharge from the right ear, accompanied by dulness of hearing in both ears. Her friends stated that she had for a long time the habit of blowing the nose very violently; and when doing so, four or five months ago, she felt as if something had given way in the right ear, and since that time has

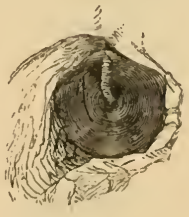


AN APERTURE IN THE POSTERIOR PART OF THE RIGHT MEMBRANA TYMPANI, FROM RUPTURE.

had discharge from it. Whenever the nose is blown, air rushes out of the right ear with a loud squeaking sound. On examining the right ear, the membrana tympani was observed to be covered

with mucus; and when the nose was blown, air was observed to issue from the tympanic cavity through a valvular fissure at the posterior part of the membrane. Watch heard at a distance of two inches. The treatment consisted in applying leeches to the margin of the meatus, in syringing out the ear with a weak solution of liquor plumbi in water, and in keeping up a slight discharge from the surface of the mastoid process. It was, however, only by slow degrees that the discharge diminished, and the orifice in the membrane closed. The membrana tympani did not regain its natural appearance, the part of it posterior to the malleus having fallen inwards towards the promontory.

Case IV. *Rupture of the membrana tympani by a twig: injury to chorda tympani nerve.*—J. L., Esq., aged 19, consulted me on September 25, 1856. A week previously, while engaged in shooting, he was endeavouring to force his way through a hedge, and turning sharp round, with the view of picking up a bird, a twig passed into the right meatus, producing a sudden and severe pain at some distance in, followed immediately by deafness and a little bleeding, which has continued to a slight extent every night since. A buzzing noise in the ear supervened soon after the accident. The pain speedily subsided. On examining the right meatus, a little coagulated blood was found; on removing which by the syringe, the membrana tympani presented a rupture extending through the greater part of its diameter, a little posterior to, and parallel with, the handle of the malleus.



AN APERTURE IN THE RIGHT MEMBRANA TYMPANI (A LITTLE POSTERIOR TO, AND PARALLEL WITH, THE HANDLE OF THE MALLEUS, NEARLY ITS WHOLE LENGTH).

The edges of the orifice were red and swollen. Air passed through it when the tympanum was inflated. Watch only heard on contact. A leech was applied to the orifice of the meatus; and a mildly astringent gargle applied gently by the syringe, twice a day. On October the 4th, the orifice had entirely healed; the buzzing noise had almost ceased; the hearing distance was

half an inch. This patient returned to India, but intelligence has been received that the hearing has greatly improved.

For days after the laceration of the membrane in the above case, there was a feeling on the same side of the tongue as if something cold had been rubbed over it; the taste on that side also was impaired. The tongue, however, was quite natural in appearance and movements, and its sensibility to touch was the same on both sides.

Case V. *Rupture of the membrana tympani by the bursting of a gun.*—W. S., Esq., aged 28, consulted me in September, 1856. Six days ago was shooting, when the gun burst in his hand, producing instant deafness in the left ear, followed, two days ago, by a copious discharge of a watery character. Yesterday there was a slight aching pain, and for two or three days every pulsation of the vessels has been heard in the left ear. On *examination*, the left meatus was found to be red and to contain purulent discharge; the membrana tympani was also red, and presented an aperture at its upper and posterior part of an oval shape, about a line in length, and nearly a line in breadth, as if a portion of the membrane had been destroyed; the mucous membrane of the tympanum was red, and the hearing distance four inches. A leech was applied occasionally to the margin of the orifice of the meatus; the ear was kept clean by daily syringing; and afterwards a lotion, the nitrate of silver (gr. x. ad ʒj) was applied on cotton wool, by means of a probe, to the surface of the membrane. The aperture slowly filled up, as if by the deposit of fibrin on the margins, which, for some time, were thicker than the surrounding portion of the membrane; and, in the course of six weeks, it was entirely closed, and the hearing power perfectly restored.

In this case the right membrana tympani was previously ruptured, and the bursting of the gun produced no effect upon that ear.

The following is a tabular view of the condition of the membrana tympani in the dissection of 1013 diseased ears:—

Opaque	15
Vascular	7
Vascular and thick	3
Relaxed	4
Tense	10

Tense and atrophied 2
Inner surface connected to the promontory by bands of membrane 32
Inner surface adherent to the incus 9
Inner surface adherent to the stapes 4
Inner surface adherent to the stapes by membranous bands . . 11
Inner surface adherent to the incus 1
Inner surface adherent to all the ossicles 2
Inner surface adherent to all the ossicles and the promontory by bands 6
Outer surface more concave than natural 34
Outer surface more concave than natural, and thick . . . 4
Outer surface more concave than natural, and opaque . . . 2
Outer surface more concave than natural, and thick and opaque . 1
Outer surface more concave than natural, and soft . . . 2
Outer surface more concave than natural, and tense . . . 2
Very concave externally, and the inner surface in contact with the promontory 10
Very concave externally, and the inner surface connected to the promontory by bands 13
Very concave externally, and the whole of the inner surface in contact with the inner wall of the tympanum; the tympanic cavity being obliterated 7
Very concave externally and thick, and adherent to the promontory 3
Thicker than natural 66
Thick and unyielding 5
Thick and white 12
Thick and soft 2
Thick and tense 5
Thick, and attached to the incus by membranous bands . . 1
Thick and vascular, and connected to the incus by bands . . 1
Thick and opaque 4
Thick, tense, and congested 2
Containing deposits of calcareous matter 14
Containing spots of cartilage 2
Flat externally 6
Flat, thick, and white 4
Epidermoid lamina thick 8
Epidermoid lamina absent 5
Dermoid lamina very vascular 1
Dermoid lamina very thick 4
Dermoid lamina very thick and vascular 3
Dermoid lamina detached from the fibrous laminæ . . . 1
Radiate fibrous lamina absent, entirely destroyed by ulceration . 3
Radiate fibrous lamina absent in parts 2
Dermoid and fibrous laminæ absent in parts, apparently from ulceration 3
Radiate and circular fibrous laminæ destroyed by ulceration in parts 6
Radiate and circular fibrous laminæ entirely destroyed by ulceration 4

Radiate and circular fibrous laminæ entirely destroyed by ulceration; the mucous lamina being attached to the promontory	2
Radiate and circular fibrous laminæ containing pigment cells	3
Mucous lamina thick	2
All the laminæ destroyed by ulceration except the epidermoid	3
All the laminæ destroyed by ulceration except the mucous	2
All the laminæ perforated	47
All the laminæ absent apparently from ulceration	21
All the laminæ perforated, the remaining portion of the membrane being adherent to the promontory	9
All the laminæ perforated, and very thick	1
All the laminæ perforated, very thick and concave, and adherent internally to the promontory	2
All the laminæ perforated by molluscous tumours	2
Upper part of all the laminæ detached from the bone	2
The circular cartilage exposed	2

CHAPTER XI.

THE EUSTACHIAN TUBE.

ANATOMICAL OBSERVATIONS — PHYSIOLOGICAL OBSERVATIONS — PATHOLOGICAL OBSERVATIONS—SEAT OF OBSTRUCTION OF THE EUSTACHIAN TUBE :—1, THE FAUCIAL ORIFICE. 2, THE TYMPANIC ORIFICE. 3, MIDDLE PART.—CAUSES OF OBSTRUCTION :—1, THICKENED MUCOUS MEMBRANE. 2, RELAXED MUCOUS MEMBRANE—*a*, OBSTRUCTION OF THE FAUCIAL ORIFICE FROM THICKENED MUCOUS MEMBRANE—THE EXPLORATION OF THE TUBE—THE OTOSCOPE—TREATMENT—USE OF THE EUSTACHIAN CATHETER AND OF THE EXPLORER—THE EXCISION OF THE TONSILS—CASES. *b*, OBSTRUCTION OF THE EUSTACHIAN TUBE AT ITS FAUCIAL ORIFICE FROM RELAXED MUCOUS MEMBRANE—SYMPTOMS—TREATMENT—CASES. *c*, OBSTRUCTION OF THE EUSTACHIAN TUBE AT THE TYMPANIC ORIFICE FROM THICKENED MUCOUS MEMBRANE—SYMPTOMS—TREATMENT—ON THE OPERATION OF PUNCTURING THE MEMBRANA TYMPANI. *d*, OBSTRUCTION OF THE MIDDLE PART OF THE EUSTACHIAN TUBE BY MUCUS, BY STRICTURE, OR BY MEMBRANOUS BANDS.

Anatomical observations.—The Eustachian tube, extending between the cavity of the fauces and that of the tympanum, is from an inch and a half to two inches in length. At its faucial orifice it is wide and dilatable, but it soon becomes so constricted as barely to admit an ordinary-sized probe. Its direction from the tympanum is obliquely downwards, inwards, and forwards.

The Eustachian tube consists of two portions,—the *osseous* and the *fibro-cartilaginous :* the osseous portion extends from the tympanic cavity to the fibro-cartilaginous portion ; and is about three-quarters of an inch in length, and about a line in diameter. It is lined by an extremely thin fibro-mucous membrane, very similar to that lining the tympanic cavity.

The *fibro-cartilaginous* portion, as its name implies, consists of cartilage and fibrous tissue, and is about an inch in length. It is of a conical form, having its apex continuous with the osseous portion, while the base extends into the cavity of the fauces in the shape of a rounded tubercle. On examination, the rounded

extremity of the cartilaginous portion is found to form a superior and inferior lip: the former projects slightly downwards, and forms the upper wall or angle of the tube; the latter turns slightly upwards, and forms the inferior angle. The fibrous membrane forming the outer wall of the tube is attached, above and below, to the two lips just described; forming anteriorly a free border, and posteriorly being attached to the anterior border of the outer part of the osseous portion. The trumpet-shaped faucial orifice of the Eustachian tube is nearly half an inch long; and its middle part may be considered to be on a level with the inferior meatus of the nose.

The use of the Eustachian tube is to allow ingress of air to the tympanum, and egress of mucus from it; but the point of importance which specially claims attention is, whether its guttural orifice remains always open, so that the air in the cavity of the tympanum is *constantly* continuous with that in the fauces. The opinion of physiologists is in favour of this view. Müller says, that the object of its being constantly open is, "that a certain degree of dulness which the sound might acquire from the resonance of the apparatus is avoided:" and adds that, "Henle supposes that the air of the cavity of the mouth and nose are in like manner evolved through the medium of the Eustachian tube, to increase by resonance the intensity of sounds entering the ear by the external meatus." *

Dr. Todd speaks of one object of the Eustachian tube being to "afford an outlet for the escape of such sonorous undulations as do not impinge upon the labyrinthine wall of the tympanum." †

Other writers differ in some measure from the foregoing view, and some physiologists are not in favour of the constantly patent condition of the Eustachian tube. Thus Mr. Wharton Jones says, "It is to be remarked that the Eustachian tube is not habitually wide open, so that the air can flow freely in and out, but that, on the contrary, in the state of rest its walls are collapsed. By this arrangement, which gives the Eustachian tube the property of a weak valve, opening either way, the too ready course of the air is opposed." ‡

* Müller's Physiology, translated by Baly, vol. ii. pp. 1270—1273.

† Cyclopædia of Anatomy and Physiology, article "Hearing," p. 576.

‡ Cyclopædia of Surgery, p. 23. 1841.

Hyrtl agrees in the above statement, and says, "The walls of the convoluted trumpet are disposed to lie upon each other and form mucous adhesions, so that, as any one can easily satisfy himself, a considerable degree of compression of the air in the mouth and nose (by means of the muscles of the cheek, the mouth being shut) is necessary to force air into the cavitas tympani." *

In a paper laid before the Royal Society, in 1853, I endeavoured to show that, in the state of repose, the faucial orifice is always shut; that the means by which it is opened are the muscles of the palate; and that it is opened during the act of deglutition. In that paper it was further pointed out, that in man and in most mammalia, the muscles opening the Eustachian tube were the tensor and levator palati, which have been long known to be attached to its orifice. In some mammalia the tube is opened by the superior constrictor of the pharynx, and in birds by the internal pterygoid muscles. That the Eustachian tube is usually shut, and the act of swallowing is the process whereby it is opened, is shown by the following experiments:— If the cavity of the tympanum be partially distended with air, by making an attempt at a forcible expiration through the nose when the nostrils are held closed, a sensation of fulness or pressure is experienced in the tympanum, arising from the pressure of the air against the inner surface of the membrana tympani: a sensation, however, which does not disappear as soon as ordinary respiration is carried on, but remains until the act of swallowing is performed, and the air thereby allowed to escape. Again, if the mouth and nose be held closed during the act of deglutition, the same sensation of pressure in the ears is felt: for during that act the air, which is slightly compressed by the muscles of the fauces, passes into the tympanic cavities; as in the former experiment, the feeling of distension is not relieved until the act of swallowing is repeated with the mouth and nostrils open. A third example proving the Eustachian tubes to be opened during the act of deglutition, and closed when the muscles of the fauces return to a quiescent state, is afforded by a person descending in a diving-bell. It is well known that during the descent the compressed air filling the

* Vergleichende Anatomie über das innere Gehörorgan des Menschen und der Saugthiere, 1845, p. 51.

external meatus produces a sensation of weight, and often of pain, by pressing the membrana tympani inwards. This sensation can, however, be at once eased by an act of swallowing, whereby the condensed air is allowed to enter the tympanum through the Eustachian tubes, and thus afford support to the inner surface of the membrane. A further proof that air enters the tympanic cavity during deglutition with the nostrils closed, and passes out again during the same act with the nostrils open, is obtained by the inspection of the membrana tympani in the living person, by means of a strong light, during the two operations: in many instances, the membrana tympani is seen to be pressed slightly outwards by the first act, and to return to its previous state during the second.

ON THE MUSCLES WHICH OPEN THE EUSTACHIAN TUBE.

Valsalva,* in his admirable treatise on the human ear, appears to have been the first anatomist who pointed out the fact, that the tensor and levator palati muscles take an origin from the Eustachian tube; he also gave them the appellation of the muscles of the Eustachian tube; but he considered that their function is to keep the tube constantly open, as he believed that "if the tube is closed, the hearing is lost at once."

Most modern anatomists have described the muscles of the soft palate as taking their origin from the Eustachian tube; but they have not ascribed to them the function of opening or of otherwise affecting the tube.

As stated, the two muscles which open the tube in man are the tensor and levator palati.

The *tensor palati* muscle arises from the fossa at the root of the internal pterygoid plate, from the adjacent bone, from the outer surface of the superior cartilaginous lip of the Eustachian tube, and from the membrane forming its outer wall; and the fibres from these several sources pass downwards, form a flat muscle which winds round the hamular process of the sphenoid bone, to be inserted into the aponeurosis of the palate, and into the ridge of the palate bone.

The *levator palati* muscle arises from the inferior surface of the petrous bone, near the apex, and from the outer half of the

* De Aure Humana Tractatus, 1735.

under-surface of the cartilaginous portion of the tube; and the fibres descend in contact with the inner half of the under surface of the tube, and are inserted into the aponeurosis of the palate, some of the fibres uniting with those on the opposite side.

The action of the *tensor palati* muscle, when it contracts, is to draw slightly outwards, and to keep on the stretch, the membrane forming the outer wall of the Eustachian tube; the action of the *levator palati* muscle is to draw downwards and keep tense the lower wall of the tube: hence it will be seen that the combined action of the two muscles is to keep open the tube by drawing the membrane forming its outer wall apart from the cartilage forming its inner wall.

As during the act of deglutition the tensor and levator palati muscles contract, it is evident that whenever that act is performed, the Eustachian tube must be opened; and inasmuch as there is no apparatus by which the faucial orifice of the tube can be kept open, its lips must fall together, and the orifice close as soon as the muscles cease their action. During the few moments that the faucial muscles are brought into play in the process of deglutition, air can either enter or recede from the tympanic cavity, and thus be always of the same density as the outer air. The reasons why the Eustachian tube is closed, save during the momentary act of deglutition, are, first, that the tympanum may be generally a closed cavity, so that the sonorous vibrations reaching it may be concentrated upon the membrane of the fenestra rotunda; and, second, that, as specially pointed out by Dr. Jago, sounds may be prevented entering the tympanum from the fauces.*

* An examination of the faucial orifice of the Eustachian tube in other animals is corroborative of the view above advanced. In *mammalia* the faucial orifice of the tube presents much variety both in structure and form. In the animals I have dissected belonging to the class *ruminantia*, there is an entire absence of cartilage at the orifice of the tube, and the aperture is guarded by a thin fold of elastic membrane; it is opened by the faucial muscles. In the *carnivora* the cartilage is prominent, and forms a distinct rounded projection. In the *rodentia* the orifice consists merely of a fissure in the mucous membrane of the fauces. In some of the mammalia the orifice is opened by the superior constrictor of the pharynx. In all the *birds* that I have been able to examine, the Eustachian tube was composed of two distinct portions, the membranous and the osseous; and no cartilage entered into their composition. The membranous portion consists of a sac, which is common to

PATHOLOGICAL OBSERVATIONS.

Although from the preceding remarks there can remain little doubt that the faucial orifice of the Eustachian tube is ordinarily closed, except during the act of deglutition, it is requisite to perfect hearing that the tube should be pervious, and that there should be a constant interchange of air in the cavity of the tympanum. If the Eustachian tube becomes impervious, the air that was in the tympanum at the time of the closure gradually disappears. It is not easy to decide whether it is absorbed, or whether by a kind of exosmose it passes through the membrana tympani; but whatever the cause, in a space of time varying in different cases from a few hours to a day or two, there is no doubt that the air in the tympanic cavity becomes partially exhausted. The effect is to produce an increased concavity in the external surface of the membrana tympani; a forcing inwards of the chain of ossicles; pressure on the contents of the labyrinth; and a very serious diminution of the hearing power.

The morbid conditions of the Eustachian tube found in 1523 dissections were as follow:—

Containing mucus	10
Containing mucus, lining membrane congested	2
Containing mucus, lining membrane thick	2
Lining membrane congested	5
Faucial portion, mucous membrane red and soft	2
Bands of adhesion connecting the walls	3
Stricture in osseous part	1
Stricture in cartilaginous part	2
Very large	2

The causes of obstruction of the Eustachian tube may be thus classified.

1. At its *faucial orifice;* a thickening or relaxation of the mucous membrane.

both ears, the upper extremity of which receives the two osseous tubes, and the lower extremity opens into the cavity of the fauces posterior to the aperture of the nares. The muscles which open the Eustachian tube in the bird are the internal pterygoid, or rather small muscles distinct from the pterygoid, but accessory to them. The common membranous tube is situated between the internal pterygoid muscles, and the lateral surfaces of the tube are in contact with, and firmly adherent to, the inner surface of these muscles or their accessories, so that when the fibres are drawn from the median line the walls of the tube are separated, and a free communication exists between the tympanic cavity and the pharynx.

2. At its *tympanic orifice;* thickening of the mucous membrane, or a deposit of fibrin.

3. In the *middle part* of the tube; a collection of mucus, a stricture of the osseous or cartilaginous portions, or membranous bands connecting the walls.

1. Obstruction of the Eustachian tube, at its faucial orifice, takes place—

(*a.*) From *thickened* mucous membrane.

(*b.*) From *relaxed* mucous membrane.

(*a.*) OBSTRUCTION OF THE FAUCIAL ORIFICE FROM THICKENED MUCOUS MEMBRANE.

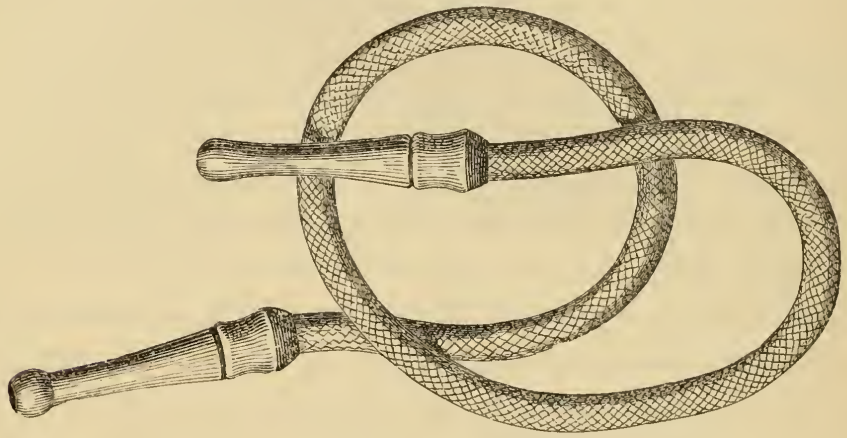
In these cases there is usually enlargement of the tonsils, or hypertrophy of the mucous membrane of the nose and fauces. If the obstruction occurs in a young person, the mucous membrane of the nose is commonly so thick as to offer some resistance to the easy passage of air, and to lead to the habit of breathing through the mouth; a habit which at night is carried out to a marked degree, and the patient often snores loudly. Upon examining the fauces, the tonsils are sometimes found enlarged, and the faucial mucous membrane is thicker than natural. In the adult the latter condition is observed, but the tonsils are less frequently affected. The deafness comes on usually rather rapidly, often subsequent to a cold, and, after remaining for a time, suddenly vanishes with a loud crack in the ear. This amelioration often accompanies the acts of yawning, gargling, or other strong muscular effort of the fauces. The improved hearing which thus results rarely continues long; sometimes it lasts for a few hours, in others for a day: a variation which probably depends upon the intervals which elapse before the air disappears from the tympanic cavity. The amount of hearing depends upon the quantity of air in the tympanum. Sometimes the patient has to be loudly spoken to close to the ear; at others a distinct voice is heard at the distance of two or three yards. There is frequently complaint of a sensation of weight or pressure in the ears, which often extends to the head, when heaviness and great depression of spirits are experienced. The latter symptom is very marked at times, but entirely vanishes with the removal of the obstruction. It possibly may originate from the pressure exerted upon the contents of the

labyrinth by the forcing inwards of the membrana tympani and ossicles. A peculiar symptom sometimes met with in this affection, and for which I am unable to account, is the improvement which takes place during the temporary position of the head on a pillow, or even if it be turned round and kept looking backwards. Irritation is often complained of in the external meatus; sometimes the dermis of the meatus becomes much congested, and eventually pours out a discharge; and where it happens that the irritation is still greater, a polypus forms, and there is a large quantity of mucus secreted. When a patient presents himself for advice, with obstruction of the Eustachian tube coexisting with polypus or the sympathetic discharge from the meatus, unless the case be most carefully examined the real disease is apt to be overlooked, and considered to be an affection of the meatus only.

On inspecting the membrana tympani, it will be found very concave, of a dull leaden hue, and its surface of an unnatural glassy aspect, the triangular spot being larger than natural. Sometimes the membrana tympani is so much drawn inwards as to approach the stapes, which is distinctly discernible through it; in other cases, the membrana tympani is somewhat opaque, and its outer surface uneven and irregular.

The exploration of the Eustachian tube.—The method of doing this is so important to a thorough examination, as to require to be treated in detail. In a paper read before the Medico-Chirurgical Society in 1853, I pointed out a simple mode of ascertaining whether the Eustachian tube was pervious, and one which, as a general rule, is successful, without having recourse to the catheter. It has already been shown, that during the act of deglutition, with the mouth and nose closed, a small quantity of air is passed through the Eustachian tubes into the tympanic cavities; a process that is attended with a sensation of fulness in the ears. The entrance of air into the tympanum can be distinctly heard by means of an elastic tube about eighteen inches long, each end of which is tipped with ivory or ebony; an instrument which I have named the Otoscope. One end of it is to be inserted into the ear of the patient, and the other into that of the medical man, who must take care that no portion of the tube touches any neighbouring body. When the patient swallows a little saliva, the mouth and nose being

closed, if the Eustachian tube be pervious, at the moment that he feels a sensation of fulness in the ear, the surgeon will hear most distinctly a faint crackling sound, produced apparently by a slight movement of the membrana tympani. This crackling sound is that most usually heard; but in some instances where the mucous membrane of the tympanum is thick, a gentle flapping sound will be detected in its place. If in a case of suspected obstruction of the Eustachian tube, the otoscope fail to reveal

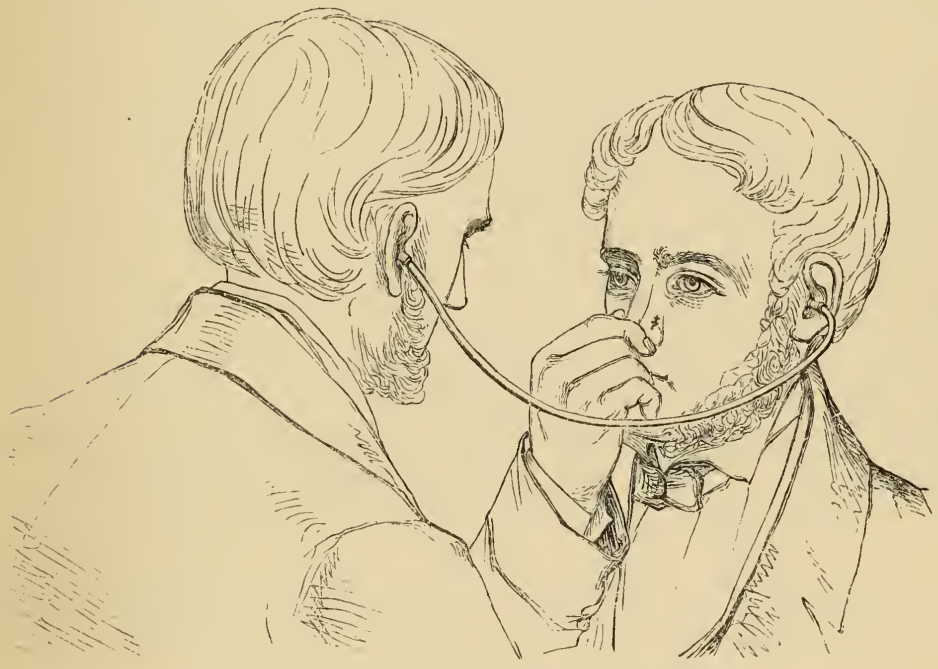


THE OTOSCOPE.

any sound during the act of deglutition; if no sound be heard when the patient makes a forcible attempt at expiration with mouth and nose tightly closed; and if the history of the case, the symptoms and appearances, agree with those already laid down as appertaining to obstruction of the Eustachian tube, I think the surgeon is justified in affirming that the tube is obstructed, and has no need to resort to the use of the Eustachian catheter. Doubtless, in many cases a person is unable to force air into the tympanum, although the pervious condition of the Eustachian tube is shown by the test of the otoscope, and this may depend upon a peculiar arrangement of the lips of the tube which causes them to be pressed together by the compressed air. There are other cases also where the tube may be proved to be pervious by the patient forcing air into it during an attempt at expiration, although the act of deglutition with closed nostrils does not call forth any sound appreciable by the otoscope; but it is rare indeed for a pervious tube to resist *both* of these tests. I have, however, met with such cases; but as their history, appearances, and symptoms have concurred in showing that no obstruction of the tube existed, it has not appeared necessary to

introduce the catheter. In certain cases the membrana tympani may be seen to move during an attempt at expiration, even though no sound could be heard; the patient, therefore, should always be asked whether he perceives any sensation in the ears during the above-named processes.

Is the Eustachian catheter then useless as a means of diagnosis? Notwithstanding its frequent use by surgeons in Germany and in France, I am disposed to think so. By paying attention to the points just laid down, it is my opinion that a case of obstruction of the Eustachian tube can always be diag-



THE SURGEON USING THE OTOSCOPE.

nosed without the aid of the catheter. Respecting its use as a remedial agent, I shall speak hereafter.

That the cause of the obstruction of the Eustachian tube at its faucial orifice is the thickening of the mucous membrane, is proved by actual dissection, by the coexistent thickening of the mucous membrane in other parts of the fauces, and by the results of the remedial measures adopted for its relief. An opinion formerly obtained a certain degree of credence in the medical profession, that enlarged tonsils frequently press upon and close the Eustachian tubes. There can be no doubt this opinion is erroneous. To convince himself that it is so, the surgeon has only to make an examination of the relative position of the tonsil and of the trumpet-shaped extremity of the tube;

when he will find the tonsil situated from an inch and a quarter to an inch and a half below the tube, and placed between the palato-glossus and palato-pharyngeus muscles, the latter muscle entirely separating the tonsil from the tube: he will also find the Eustachian tube close to the base of the skull, against the basilar process of the occipital bone, and surrounded by the tensor and levator palati muscles, the function of which is, as already shown, to open the tube. Repeated examinations have convinced me that even should the tonsil enlarge to its greatest possible known extent, it never reaches the Eustachian tube; for, together with the enlargement of the tonsils, the palato-pharyngeus muscle also hypertrophies, and effectually separates the two organs. Nay, further, in the cases seen by me, where the tonsils have been the largest, there has been no deafness; a fact which must also have been observed by other medical men. Often in a case of obstructed Eustachian tube in one ear, the tonsil has been comparatively small on the deaf side; while on the opposite side, where there has been no deafness, the tonsil has been large. There is no doubt that obstruction from hypertrophy of the mucous membrane of the faucial orifice of the Eustachian tube may coexist with enlarged tonsils; but the mere coexistence of two affections must not be confounded with cause and effect.

TREATMENT OF OBSTRUCTION OF THE FAUCIAL ORIFICE OF THE EUSTACHIAN TUBE BY THICKENED MUCOUS MEMBRANE.

Cases of this disease, when uncomplicated with any affection of the tympanum, ordinarily yield to the use of general remedies and applications to the fauces, without touching the outer ear. The object to be aimed at is the reduction of the congestion and hypertrophy of the mucous membrane surrounding the orifice of the tube, so as to allow the muscles again to exercise their function of opening it; and for this purpose considerable patience and perseverance are, doubtless, frequently required; since in many strumous persons, especially if young, the tendency to congestion and thickening is very great.

General remedies.—The most efficient of these are abundant and active exercise in the open air, and warm clothing. Flannel should be worn next to the skin. In youths the flannel jacket, extending from the neck to the ribs, may not only be worn; but

in cold weather, in front, where the chest is exposed, a small additional piece of flannel may be worn suspended from the neck. The throat should not be wrapped up with handkerchiefs, comforters, boas, &c., as they only serve to weaken it, by keeping it warm for a certain time, and then, on their removal, leaving it exposed frequently to a colder air within doors than had prevailed without, thus bringing on relaxation of the mucous membrane. Where a single tie handkerchief is worn within doors, no addition is needed on going out; and where in children the throat is left bare within the house, a small silk handkerchief *loosely tied* is all that is required without. I have been thus particular on these points, because experience frequently convinces me of their great importance.

The surface of the body should be daily sponged or rubbed with a coarse towel that has been dipped in cold water, and then wrung out. As the children who suffer from the affection under consideration have usually a languid circulation and deficient nervous energy, the towel bath appears to be a remedy advantageous in both respects. The towel should be very coarse, and only one part of the body should be rubbed at a time. The skin, especially that of the neck, throat and spine, should be brought to a ruddy glow. This bath may be used either in the morning or the evening, but once daily is sufficient. If the patient be so very delicate that he cannot well bear the slight shock produced by the cold towel, tepid water may be used. In addition to this bath, indeed to supersede it, especially in youths of from fourteen to sixteen, by whom it is not likely to be carried out effectually, the tepid or cold plunge bath may be resorted to. When it can be practised, sea-bathing should not be neglected; but in all cases of entire immersion it is advisable to wear an oil-skin cap, to keep the head dry: and this, not because the application of water to the head is objectionable, but because there is so great a difficulty in perfectly drying the hair, and the slow evaporation from it is often decidedly injurious. Plunging into a fresh-water river in warm weather is not prejudicial. In the treatment of the cases in question, too much stress cannot be laid upon the necessity of exercise, bracing air, and cold bathing. I have known them to overcome the most obstinate cases of obstruction of the faucial orifice of the Eustachian tubes, where all local remedies and medicines had given slight or only temporary

relief. Care should also be taken as to the diet of the patient: pastry, sweets, fat, &c., should be avoided; vegetables may be sparingly partaken of; and the principal food should be bread, especially that containing the bran, meat and light puddings, as rice, sago, &c. Children should not be overworked in their studies, should retire early, and their sleeping-rooms should be airy and well ventilated (it is a good plan to leave the bedroom-door ajar during the whole of the night); and, above all, it is important that the head should be kept above the bed-clothes.

To overcome the very prevalent habit of breathing through the mouth, whereby the cold air keeps up a constant irritation of the faucial mucous membrane, the patient should be directed to sit down quietly for a certain time daily, and practise the habit of nasal respiration. Although it may at first seem difficult, the mucous membrane of the nose soon yields, and the air passes freely.*

Medicines.—All medicines that impart tone to the system, may in turn be resorted to. Cod liver oil, iron in various forms, iodide of iron, iodide of potassium, creasote, and the mineral acids and vegetable bitters, will be found useful.

Local treatment.—The most efficient local application is undoubtedly the nitrate of silver, which may generally be used in a solid form. Messrs. Weiss have made for me a caustic holder, the end of which is capable of being turned at such an angle, that the caustic may be passed behind the soft palate, and applied to the mucous membrane of the orifice of the tube, as well as to that of the fauces. Should the tonsils be enlarged, the solid nitrate of silver may be rubbed over their surface, and over that of the faucial mucous membrane about once a week; and it should produce considerable irritation and a copious flow of mucus. Stimulating gargles are also to be used; those combining acids and astringents are of service. Iced or cold water is often beneficial; and in order to ensure the application of the cold water to the orifices of the tubes, as well as to improve the condition of the mucous membrane of the nares, the water may be drawn up through the nose, and passed out by the mouth.

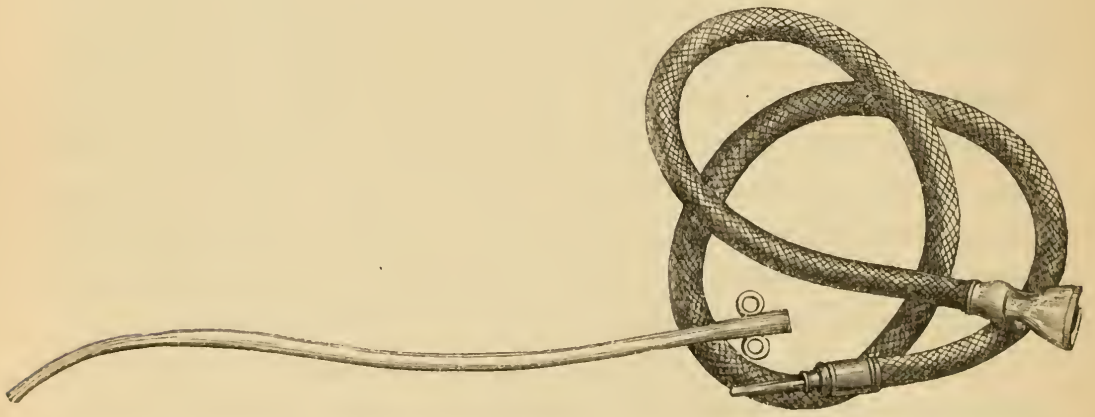
* Many years ago I pointed out the peculiar erectile tissue of which the nasal mucous membrane is composed, not only in man, but in most mammalia; this tissue renders it a most efficient natural "respirator."

When there is much congestion of the faucial mucous membrane, a leech or two, a stimulating liniment, or a vesicating paper, may be applied over the region of the tonsils.

The use of the Eustachian catheter.—It was, and is even now, the custom of some surgeons to pass the Eustachian catheter repeatedly in cases of obstruction of the Eustachian tube. Now, what is the effect of this procedure? If the mucous membrane be not much thickened, air is blown into the tympanic cavity, and the power of hearing is improved. As soon, however, as the catheter is withdrawn, the tube again closes, and its muscles have not the power to re-open it; while the air which has been forced into the cavity soon disappears, and the deafness returns. The patient again seeks relief from the same process and with the same result; for if the mucous membrane is allowed to remain in its existing state, no permanent relief is to be hoped for; on the contrary, the repeated use of the catheter tends rather to increase than diminish the congested state of the membrane. Under certain circumstances, however, the Eustachian catheter is of great value. The judicious course respecting it, is to use the above-named plans for the purpose of reducing the hypertrophy of the mucous membrane, which will, in the majority of cases, effect the cure of the disease. If, after pursuing these measures for ten days or a fortnight, no amelioration ensues, the Eustachian catheter may be introduced and air blown through the tube into the tympanum; an operation which may at times possibly facilitate a cure by the removal of mucus from the tube, or by liberating the lips of the faucial orifice. Several days, however, should elapse before the operation, if required, is repeated, and this will seldom be the case.

The mode of applying the Eustachian catheter.—It has been already stated that the orifice of the Eustachian tube is posterior and external to the posterior aperture of the inferior nasal meatus. The catheter used by me is not quite so large as an ordinary crowquill; and as the outer part of the Eustachian tube is oval, it has been recently suggested by me that the extremity of the catheter should be of the same shape. The end of the catheter taken hold of by the surgeon should be rather larger than that which is to enter the tube, in order that the end of the *explorer*, or the nozzle of a syringe, may be fixed in it. This end having a ring on the side opposite to the concavity of the

curved end, is to be taken in the right hand of the surgeon, the patient being seated in a chair before him, and then the instrument, with the point downwards, is to be made to glide backwards, by the side of the *septum nasi*, until the curved end reaches the cavity of the fauces, when it is to be pressed backwards against the mucous membrane of the posterior part of the fauces. It is next to be drawn slightly forwards, and then rotated outwards, so that the extremity may turn upwards and catch the orifice of the Eustachian tube, which can be distinctly felt, and will prevent the further rotation of the instrument. The catheter is now to be pressed slightly outwards and backwards, when the surgeon will feel it to be embraced by the tube. For the purpose of securing the instrument, a frontlet bandage, with a pair of forceps attached, has been used; but it may be dispensed with in all ordinary cases: for the surgeon has only to transfer the catheter to his left hand, and while holding it lightly, so as not to cause pain to the patient (as the use of the frontlet invariably does), insert into the dilated end of that instrument the small end of the explorer or of the syringe. The *explorer*, which in my hands has entirely superseded the



THE EXPLORER, AND THE EUSTACHIAN CATHETER INTO WHICH IT FITS.

use of the air-press, consists of an elastic tube, about eighteen inches long, one end of which has a flat mouth-piece of ivory, with one or two deep incisions upon it, to enable it to be easily held by the incisor teeth of the operator, while the other end has a small portion of steel tubing attached to it, which fits accurately into the further end of the catheter.

When the catheter has been properly fixed, as directed, in

the tube, and held there by the left hand of the surgeon, one end of the explorer is to be placed in his mouth, and the other in the catheter, and held there also by the left hand. With his right hand thus left at liberty, the surgeon is now to take the *otoscope* and introduce one end of it into the ear of the patient, who may hold it there, the other end being held by the surgeon in his own ear ; or the tube may be made so light as to

THE SURGEON USING THE EUSTACHIAN CATHETER AND THE EXPLORER.

remain there without being held, leaving the operator's right hand still free.

The medical man next proceeds to blow air gently through the explorer, at the same time that he listens through the otoscope to ascertain whether the air enters the ear, and if it does, what is the peculiar sound it produces. When the tympanum is unobstructed by mucus, the air is heard to pass in a stream against the inner surface of the membrana tympani, but when mucus is present, a peculiar gurgling is heard ; and if the mucous membrane itself is thickened, a peculiar squeak or bubbling is also perceptible. It is not advisable to blow with force into the ear, but rather to make a few gentle successive puffs, attentively listening during each, to detect the kind of sound that may be heard in the tympanum. Sometimes no air enters, the mucous membrane being too thick to allow it to pass ; and, under such circumstances, it is unwise to attempt to force

the air into the tympanum. Great mischief has, indeed, frequently resulted from such a proceeding; the mucous membrane having been lacerated, and the air been driven into the submucous tissue, causing extensive emphysema. Nay, still more serious results have occurred, the patient having been killed instantaneously, perhaps through the effusion of air through the fenestra rotunda (the membrane having been lacerated) into the labyrinth, and the shock upon the nervous system causing instant death. Nor need it be a source of surprise that the effusion of air into the labyrinth should prove fatal, since even the forcible distension of the tympanum, while blowing the nose frequently, produces giddiness by pressure upon the labyrinth.

The excision of the tonsils.—On the supposition that the tonsil, when enlarged, pressed against and closed the faucial orifice of the Eustachian tube, the operation for excision, or partial excision, of the tonsils, has long been practised for the relief of deafness. Although, as already shown, the tonsil, however hypertrophied, cannot cause occlusion of the Eustachian tube, still the removal of a portion, in cases where it is *much enlarged*, is sometimes of service by diminishing the congestion of the mucous membrane at the orifice of the tube; and it perhaps also operates beneficially by allowing the muscles of the tube to act more freely. This operation is, however, very rarely required; and the best rule to follow is never to excise a portion of the tonsil, which appears to have important functions, independent of the fauces, unless it evidently interferes with the general health of the patient, or unless the obstruction of the Eustachian tube resists the other measures already indicated.

CASES OF OBSTRUCTION OF THE EUSTACHIAN TUBE BY THICKENED MUCOUS MEMBRANE, AT ITS FAUCIAL ORIFICE.

Case I.—Master M. J., aged 15, was brought to consult me, on December 4, 1852, on account of a very serious diminution of the hearing power, in both ears. He was in tolerable health, but pale. About a year previously, after suffering from a bad cold, he became dull of hearing, and since then has been able to hear only when spoken to in a loud voice, within the distance of a yard or two. Occasionally he has felt a sensation as of something bursting in the ears, which has been followed by slight, but only temporary relief. Upon *examination*, the mucous mem-

brane of the fauces was found very thick and red, and both tonsils greatly enlarged. The *right ear*.—Watch heard only when in contact with the ear; the membrana tympani being opaque, of a leaden hue, and more concave externally than natural, while, instead of the usual triangular bright spot, two bright spots were perceptible, showing that the membrane was deprived of its ordinary evenness of surface. Upon listening with the *otoscope* while the patient swallowed, the mouth and nose being closed, and while he tried to force air into the tympanum, no sound was heard. The *left ear* was in a very similar state to the right; the watch, however, could be heard at a distance of two inches from the ear. Feeling assured from the history of the case, the symptoms, the condition of the throat, the appearances of the ear, and the negative results following the use of the otoscope, that the Eustachian tube was closed at the faucial orifice, especially as there was no indication of disease in the tympanum, which might lead to the supposition of the tympanic orifice being affected, I did not use the Eustachian catheter, but proceeded at once to apply a solution of nitrate of silver to the mucous membrane of the fauces, and to the orifices of the Eustachian tubes. Three grains of the sulphate of iron were given daily in combination with ten grains of sulphate of magnesia, and slight counter-irritation was kept up over the region of the tonsils. As a remedial measure, the catheter was not resorted to, as it was evident that the hypertrophy of the mucous membrane had slowly come on, and it was not probable that it could be otherwise than slowly improved. The first effect of the treatment was a slight improvement of the hearing, although the tube remained impervious; an improvement which probably depended upon the diminution of the congestion in the mucous membrane of the tympanum. By the end of January, the hearing power of the right ear had greatly improved; and in the middle of February, the air passed freely through the Eustachian tubes during the act of deglutition, and the patient heard quite well again.

Case II. *Obstruction at the faucial orifice for two months.*—W. W., Esq., aged 52, being strong and in good health, consulted me on July 26, 1853. He stated that two months previously, after a bad cold, he became slowly deaf in both ears, so as to require persons to speak loudly to him within the distance of a

yard. On the 24th, after yawning, he suddenly experienced a crack in the left ear, and as suddenly heard well: but this improvement only lasted for a day, and then the deafness slowly returned. He has had three similar attacks during the last ten years, but in about a month's time the hearing usually returned after a cracking sound in the ears. At times, on throwing the head back, he has found the hearing power in the right ear much improved. On *examination*, the mucous membrane of the fauces was red and hypertrophied.

Right ear.—Hearing distance three inches; the meatus was red and hypertrophied, the *membrana tympani* more concave than natural, its surface uneven, and, instead of the single triangular bright spot, there were two smaller spots.

Eustachian tube.—The otoscope did not detect any air entering the tympanic cavity during the process of deglutition, or upon an attempt at a forcible expiration with closed nostrils.

Left ear.—Watch heard only when in contact with the ear; the membrana tympani was in a similar state to that of the right ear, and the long process of the incus could be seen through it. The Eustachian tube was impervious.

By the use of stimulating gargles and a liniment over the ears and throat, the patient entirely recovered in the course of a fortnight.

Case III. *Obstruction of the faucial orifice: catarrh from meatus: tonsils very large: cure without excision.*—Master B., aged 16, was brought to consult me in August, 1850. His general health was not very good, and he was subject to glandular enlargements.

History.—The right ear has always been slightly dull, and for two or three years it has been worse. The left ear lately has also become so dull, that he requires to be spoken to distinctly within the distance of a yard from the head. Has had several attacks of ear-ache; after which, and also after a cold, the deafness is increased. Has had discharge from each ear on several occasions, and complains of a singing in them. When asleep he makes a loud snoring sound, and he always breathes through the nose. At times has had a cracking sound in the ears, which has been followed by a temporary improvement. On *examination*, the tonsils were found to be so greatly enlarged as nearly to touch the median line, while the mucous membrane of the fauces and of the nose was much thicker than natural.

Right ear.—Hearing distance half-an-inch; membrana tympani concave; bright spot somewhat dull. Eustachian tube impervious.

Left ear.—Hearing distance two inches; the bright spot of the membrana tympani sub-divided. Eustachian tube obstructed.

As the tonsils in this case were so much larger than natural, and as they apparently interfered with the respiration of the patient, and perhaps with his health, it was thought that the removal of a portion of one or both might be attended with benefit: but the patient's friends so strongly objected to the operation, that it was not performed. The *treatment* consisted in the application of solid nitrate of silver to the fauces; in the use of an astringent gargle with counter-irritants over the ears and throat; in the administration of tonic medicines; and in careful diet, with abundant exercise in the open air. On August 21st, a crack took place in the left ear, when he heard perfectly for a short time. After this date, a succession of cracks was heard in each ear, and at last the hearing power entirely returned and remained perfect, except during a cold, the effects of which, however, soon disappeared.

Case IV. *Obstruction from the mucous membrane of the fauces: polypus in meatus externus. Removal by operation. Cure.*—H. W., Esq., aged 19, was sent to me by Mr. White Cooper, in February, 1854, on account of a considerable diminution of the power of hearing, and of a discharge from the right ear. His health was not very good, and he was subject to enlarged cervical glands. The *history* of the case was, that about two years ago he found himself becoming gradually dull of hearing. After this dulness had remained some months, accompanied by a feeling of fulness in the ears, a discharge took place from the right ear, the quantity of which has lately considerably increased. On *examination*, the mucous membrane of the fauces was observed to be red and thick.

Right ear.—The watch heard only when in contact; a raspberry polypus, the size of a small pea, was seen to fill the meatus, close to the membrana tympani.

Left ear.—Hearing distance six inches; membrana tympani opaque, and calcareous in parts. Each Eustachian tube was impervious to air. The *treatment* consisted in the removal of

the polypus by means of the lever-ring forceps. The membrana tympani was then observed to be white. Astringent and acid gargles were used; slight counter-irritation was kept up over the ears and the region of the fauces; tonics were administered; and daily sponging with cold water was enjoined. In the course of a week a crack took place in the right ear, followed by immediate great improvement of the hearing; this was succeeded by a crack in the left ear, and a perfect restoration. The discharge also wholly disappeared. On seeing this patient several months afterwards, I found his hearing perfect, and there had been no return of the discharge.

I have said that the use of the Eustachian catheter is rarely required, because the state of the mucous membrane generally so much improves by means of the other remedies. In the following case, however, where there was an additional cause of impediment besides the thickened mucous membrane, the catheter was used with advantage.

Case V. *Impervious condition of the tube from hypertrophy of the mucous membrane at the faucial orifice; fissure of the palate; catheter used with advantage.*—Dr. P., a medical man, aged 43, consulted me in 1853, on account of deafness.

History.—Several years previously he had a disease of the palate, which terminated in the loss of a considerable portion of the palatal processes of the superior maxillary and palatal bones, and caused a large fissure. During the last two or three years he has suffered from attacks of deafness during a cold, which, after continuing for some weeks, have disappeared. On *examination*, the mucous membrane of the fauces was found to be red and much thicker than natural. Towards the posterior part of the palate was a large fissure exposing the trumpet-shaped extremity of the Eustachian tube; the mucous membrane of which was much swollen. Each membrana tympani was of a leaden hue and very concave; and there was an appearance of redness beyond each, as if the mucous membrane were congested. The patient had to be spoken to distinctly within the distance of a yard. The Eustachian tubes were impervious.

Treatment.—A solution of nitrate of silver (℥ij @ ℥j) was applied to the mucous membrane of the fauces and to the orifices of the tubes; an astringent gargle was ordered, and gentle

counter-irritation over the throat. This treatment produced a slight improvement; but as the deafness soon returned, as the patient was especially anxious to hear, and as it appeared probable that the muscles of the tube were partially disabled from performing their function, I passed the Eustachian catheter, and, by means of the *explorer*, blew air into the tympanic cavities. The good effect was instantaneous, and the patient heard well. The improvement, however, lasted for only about twelve hours, when the deafness gradually returned. At the desire of the patient I passed the catheter on several occasions, while other treatment was being followed. After each operation the hearing improved for about the same space of time; ultimately the condition of the mucous membrane was so much improved as to allow the muscles to open the tubes, and a cure resulted.

In some cases after the Eustachian tube has been obstructed for a long time, the patient may almost wholly lose the power of hearing. These cases, as will be seen by the following instance, are by no means to be despaired of.

Case VI. *Obstruction by thickened mucous membrane of the faucial orifice; duration of many years; great and prolonged hardness of hearing; cure.*—Miss J. A. O., aged 12, was brought to me from Manchester, on the 16th April, 1853. She was strong, but rather pale. The history of the deafness was, that during several years she had been dull of hearing during a cold; on the disappearance of which, the power of hearing partially returned, so that she could hear without much difficulty. For some months the deafness has been so much worse, that she cannot hear unless spoken to in a loud voice into the left ear, the right being useless. On *examination*, the mucous membrane of the fauces was found to be red, thick, and spongy, but the tonsils were not larger than natural. The mucous membrane of the nose was very thick and red; and respiration was usually carried on by means of the mouth.

Right ear.—Watch heard on pressure, but indistinctly; membrana tympani concave, surface uneven; and on that surface three irregular-shaped bright spots were seen. Eustachian tube impervious.

Left ear.—Watch heard when pressed; membrana tympani and Eustachian tube the same as in the opposite ear.

Treatment.—The solid nitrate of silver was directed to be

applied to the mucous membrane of the fauces once a week; counter-irritation over the ears, and a leech or two at times over the region of the fauces; the one-thirtieth of a grain of the bichloride of mercury twice daily, and a warm bath once a week: occasionally an emetic was also given. She returned to Manchester, and on the 28th of May her father wrote to me, saying that she was "so much better that she can keep up a conversation across the table." The child had a relapse in the following January, but a repetition of the treatment again restored her to perfect hearing.

It is not, however, only in long-standing cases of obstruction of the Eustachian tube that the deafness is very considerable; in weak persons almost total deafness may come on in a few hours. A well-marked case of the kind has occurred to me while writing the present chapter.

Case VII. *Sudden obstruction of each Eustachian tube from congestion and thickening of the mucous membrane of the fauces, producing total deafness in a few hours; cure.*—Dr. B., on the 24th January, 1855, called to ask me to see his wife, of whom he gave the following *history.*

For several months she has been much out of health, and confined to her room; but has never suffered from any deafness or disease of the ear. On the night of the 20th instant she awoke, complaining of a loud singing in the ears; and when spoken to, it was found that she was so deaf as not to be able to comprehend what was said, although addressed very loudly. If possible, this deafness increased, so that on the 22nd *no sounds* were heard, and all communication had to take place in writing. On *examination*, on the 24th, I found that the deafness was *complete;* each membrana tympani was very concave and dull; the mucous membrane of the fauces was very red and thick, the tonsils and uvula much swollen. Each Eustachian tube was impervious. Upon inquiry I learnt that accidentally a part of the window had been left open during the night. The *treatment* recommended was the application of the solid nitrate of silver to the fauces and the orifices of the Eustachian tubes. This was done freely about eleven o'clock on the 26th. Dr. B. returned home about two hours after, and found the hearing so improved that he carried on a conversation with his wife in a loud voice.

I might add to the above a large number of cases in which the treatment was quite successful, but will merely give the leading particulars of another.

Case VIII.—H. L., Esq., aged 28, consulted me on June 25, 1853. Has suffered for several months from sore throat, consequent upon an attack of secondary syphilis : for two months has complained of deafness in both ears, so as not to hear any except a loud voice. The deafness is accompanied by constant singing, which is increased when the head is on the pillow, and it varies much. On one occasion, after gargling the throat, heard much better with the right ear for twelve hours. On *examination* of the *right ear*, the hearing distance was half an inch ; the membrana tympani was opaque and of a leaden hue ; the surface shone, but the bright spot was nearer the circumference of the membrane than natural. The Eustachian tube impervious. The *left ear* was in the same condition as the right. The treatment pursued was the use of the nitrate of silver to the fauces, and the administration of steel wine. On July 2nd he told me that three or four days previously he heard quite well in the morning, and the improvement lasted for two days, since which he has been gradually getting deaf again. By perseverance in the treatment for a month he perfectly recovered.

(*b.*) OBSTRUCTION OF THE EUSTACHIAN TUBE AT ITS FAUCIAL ORIFICE FROM RELAXED MUCOUS MEMBRANE.

This affection is far from being so frequently met with as obstruction arising from *thickened* mucous membrane. In many symptoms the two affections greatly assimilate, but they also present certain decided differences. Obstruction from relaxed mucous membrane occurs less frequently in children or in persons subject to glandular enlargements, than in persons who have no thickening, but simply a relaxed state of the mucous membrane of the fauces. The physical cause of the obstruction appears to be a relaxed condition of the mucous membrane covering the faucial orifice of the tube, so that its muscles are unable to separate the lips sufficiently to admit the air. The predisposing cause is generally some debilitating influence, as over-work, keeping late hours, indigestion, &c. The exciting cause is often a cold. There is usually no history of any previous affection of

the ears, the deafness coming on slowly, and gradually increasing until the patient is unable to hear ordinary conversation, and requires to be spoken to in a loud voice. Sometimes the patient improves for a short time, and then the deafness returns; but frequently the hearing is better when the head is placed in a recumbent position, or when the face is turned and looks backwards. There is often a feeling of weight in the ears, with a singing sound, and at times a sensation of confusion in the head. On *examination*, the patient generally looks pale and out of tone; the pulse is weak; the mucous membrane of the fauces is either relaxed and red, the blood-vessels being large and presenting long streaks; and the uvula is either hanging down, so as to touch the dorsum of the tongue, or it is of a much paler colour than natural from being deprived of its due supply of blood. The membrana tympani is much more concave than natural, frequently of a leaden hue, its surface being glassy. Not unfrequently the long process of the incus is seen through it. Upon exploration with the otoscope, the Eustachian tube is found to be impervious. The *treatment* differs somewhat from that of cases of obstruction from thickened mucous membrane. Instead of nitrate of silver, stimulating gargles are to be used—one composed of whiskey is often very serviceable; tonic medicine and stimulants are to be administered, generous diet, rest from work, country air and abundant out-door exercise, should also be prescribed. Similar reasons to those which induce me not to use ordinarily the *Eustachian catheter* in cases of obstruction from thick mucous membrane, have prevented my resorting to it in the cases under consideration. Its use could not, of course, diminish the cause of obstruction, or facilitate the progress of the treatment; and unless the patient, from some particular circumstances, was very desirous to hear well during a few hours, the introduction of this instrument should be avoided. A cure is always to be effected without it.

Case I. *Obstruction of the left tube from relaxed condition of the mucous membrane; constant beating sound.*—J. R. H., Esq., a surgeon, aged 48, consulted me on December 15, 1823. The *history* was, that about six weeks previously he found himself deaf in the left ear; he felt no pain, but there was a constant sensation of beating in the ear, and a weight on that side of the head, which caused extreme discomfort. He is subject to a

relaxed throat. On *examination*, the mucous membrane of the fauces was observed to be relaxed, though not thicker than natural; the meatus externus of the *left ear* was dry and smooth, and did not contain any cerumen; the membrana tympani was very concave and somewhat opaque. The *processus brevis* stood out very prominently; but the manubrium was so much drawn inwards that it could scarcely be seen. The otoscope showed the Eustachian tube to be impervious. The watch heard only in contact with the ear. The right ear perfectly natural.

Treatment.—A whiskey gargle was ordered, and a mustard plaister to be placed on the region of the fauces; the outside of the throat to be rubbed with a coarse towel dipped in cold water; simple food, as much rest and as little "night-work" as possible.

December 24th.—A crack took place in the ear, and the hearing became perfect for a few minutes, but again became gradually dull. The treatment was persevered in, and on the 7th January, 1854, the gentleman wrote, "I am quite well; the air passes into the ear perfectly well." All the unpleasant symptoms had subsided.

Case II. *Obstruction in each tube for ten days after an attack of bronchitis.*—S. S., Esq., aged 51, an architect, was brought to me on June 24, 1853.

History.—He has had a bad cough and bronchial affection for a month, which came on after having been considerably overworked. Ten days ago deafness came on slowly in both ears, and has remained till now; so that he has to be spoken to in an elevated tone within a yard. He hears much better in the morning when reclining in bed. Has frequently tested his hearing by means of his watch, and the result is, that when lying down he can hear it at a distance of two feet with either ear; but after being in the erect posture for a minute or two the deafness returns, and he can hear the watch only at two inches from the ears. He has now and then had a slight crack in each ear, followed by somewhat improved hearing. On *examination*, the pulse was weak and slow, the face pale and flabby, and the mucous membrane of the fauces was seen to be relaxed, with enlarged streaky vessels ramifying in it.

Right ear.—Watch heard only when in contact with the ear; the surface of the membrana tympani was dull, had a dark

leaden hue, and the membrane was much more concave than natural, having two irregular-shaped bright spots in place of the single one; the long process of the incus was seen through the membrana tympani, and appeared to be in contact with its inner surface; the Eustachian tube was impervious.

Left ear.—Similar to the right: hearing distance, a quarter of an inch.

The *treatment* consisted in the administration of the citrate of iron, followed by decoction of bark and sulphuric acid; the use of a tannin gargle and gentle external counter-irritation. He was also advised to sleep in the country, to work as little as possible, and to live generously. On July 2nd there was a slight improvement, but as yet no free passage for the air through the tubes. On July 7th a sudden and great improvement took place in the right ear, after blowing the nose. Hearing distance, six inches in the right, and a quarter of an inch in the left ear. Cracks now occurred in both ears from time to time, and were followed by great amelioration in the hearing. At the end of July he had perfectly recovered.

Case III. *Obstruction at the faucial orifice from relaxed mucous membrane for two months after influenza.*—Miss T., aged 16, was brought to me on June 7th, 1853. She was pale, with a weak pulse, and somewhat out of health, having had an attack of influenza for two months. Catamenia irregular.

History.—When a child, was subject to dulness of hearing during a cold, but recovered as soon as the cold passed away. During the recent attack of influenza has been so dull of hearing as to require to be spoken to distinctly within the distance of a yard: general conversation is not heard. Sometimes during an entire day hears rather better. Complains of a ticking noise in the ears.

Results of *examination: right ear.*—Watch only heard on pressure; membrana tympani; surface dull, concave; Eustachian tube impervious. *Left ear.*—In the same state as the right. The mucous membrane of the fauces was relaxed.

Treatment.—Considering that the relaxed condition of the faucial mucous membrane was dependent upon the state of the health, steel was administered, and plans for invigorating the system were recommended: gentle counter-irritation over the region of the fauces was also enjoined.

July 13th.—Has had a "rumbling" sound in the ears, since which she has been better. Hearing distance, two inches.

July 20th.—Well. Eustachian tubes pervious.

Several additional cases might be related, but the three I have mentioned will be sufficient to illustrate the nature of the affection.

(*c.*) OBSTRUCTION OF THE EUSTACHIAN TUBE AT THE TYMPANIC ORIFICE FROM THICKENED MUCOUS MEMBRANE.

Inasmuch as one of the most common affections of the ear is inflammation of the tympanic mucous membrane, it will be readily conceived that obstruction of the tympanic orifice of the Eustachian tube is likely to take place from the same cause. It is well known that the osseous portion of the Eustachian tube, which is about the size of an ordinary probe, is lined by an extremely thin mucous membrane, which, like that covering the osseous walls of the tympanum, adheres firmly to the surface of the bone, and appears to act in the twofold capacity of a periosteum and mucous membrane; one of the reasons for its extreme tenuity being the fact that the bony part of the Eustachian tube forms part of the cavity with resonant walls. The whole of the mucous membrane of the Eustachian tube, excepting at the two extremities, is so surrounded by muscles and bone as to be little liable to become the seat of disease. In making dissections, I have rarely found that it has been morbidly affected; indeed, in some cases of ulceration of the faucial mucous membrane in scarlet fever, accompanied by ulceration of the mucous membrane of the tympanum, the membrane lining the central portion of the tube has been found free from disease. It would thus appear that the commonly received opinion of the extension of the disease, by direct continuity, from the fauces to the tympanum, is not always correct; and from observation of what occurs in other cases, there is no difficulty in conceiving the affections of the two parts to originate at the same time without any relation of cause and effect. It cannot be doubted that it is very fortunate the mucous membrane of the central part of the tube is so little liable to become thickened, since it would of course be very difficult to act upon it effectually.

The mucous membrane covering the bone which forms the tympanic aperture of the tube is, on the contrary, liable to con-

gestion and hypertrophy, being, like the mucous membrane of the tympanum, exposed to the influence of the cold air entering the meatus externus. Symptoms arising from this cause are usually present in the cases under consideration; but there is generally in addition a great concavity of the membrana tympani, loud noises in the ears, and, upon examination, an impervious state of the Eustachian tube.

The *history* of the two cases differs in the fact, that in cases of obstructed Eustachian tube, the deafness generally comes on rapidly, often disappears, and as rapidly reappears; whereas in those arising from disease in the mucous membrane, the progress is usually slow and regular. It must also be remembered, that in cases of obstruction of the Eustachian tube at the tympanic orifice, there is commonly a history of previous attacks of inflammation in the tympanic mucous membrane, which is not often the case in instances of obstruction at the faucial orifice: the membrana tympani also presents appearances indicative of inflammation having occurred in the tympanic cavity. The most simple cases of obstruction of the Eustachian tube at the tympanic orifice are those following an ordinary cold, in which a sense of fulness is felt in the ears, often attended with noises, and with dulness of hearing—symptoms which last for a few days, and then ordinarily disappear with a sensation of something bursting in the ear.

In the *treatment* of these cases, all those measures should be resorted to which will be described as serviceable in hypertrophy of the mucous membrane of the tympanum. In addition, the operation of puncturing the membrana tympani is sometimes advisable.

ON THE OPERATION OF PUNCTURING THE MEMBRANA TYMPANI.

Since Sir Astley Cooper obtained a medal from the Royal Society, on account of the success which, in a few cases, followed the operation of puncturing the membrana tympani, this operation has been performed frequently, and in cases of deafness arising from every possible cause. Though, doubtless, in certain cases it may be of great service, it is an operation rarely required, and one which, if not judiciously performed, is liable to produce the most injurious consequences. In Sir Astley Cooper's suc-

cessful cases, there was simple obstruction of the Eustachian tube; and there is little doubt that the affection would have yielded to simple measures having for their object the removal of the obstruction, while the cure instead of being temporary would have been permanent. In the great majority of cases where Sir Astley punctured the membrana tympani not the slightest benefit accrued, because the deafness was dependent upon other causes than obstruction of the Eustachian tube; and in some cases of deafness from debility of the auditory nerve, the shock of the operation greatly aggravated the symptoms. In what cases, then, should the operation be performed? It will be observed that I have not recommended it in cases of obstruction of the faucial orifice of the Eustachian tube, because that obstruction can be otherwise removed; but should the faucial orifice be permanently closed by adhesion of its walls (a case never met with by me), there can be no question that it should be performed. It is also called for in cases of stricture of the osseous portions of the tube, in those of obstruction by fibrinous effusion, and where the thickened mucous membrane of the tympanic orifice will not yield to other treatment. Great and immediate improvement frequently follows the operation; but there is usually so much difficulty in keeping the aperture open, that the value of it is much diminished. The ordinary instrument for performing the operation is the sharp triangular end of a probe; and where only temporary effect is required, this is sufficient. Fabrizzi invented an instrument for drilling out a circular portion of the membrane; but the extreme sensitiveness of the outer surface of the membrana tympani renders it difficult of application. It consists of a silver tube, about four inches long, one end of which, about a line in diameter, is tipped with steel and made to cut; the opposite end is made to screw on the outer part of a trocar, near its handle; while the trocar, consisting of a silver rod, has at its end a fine wire shaped like a corkscrew. When used, the trocar is passed through the canula, and the spiral wire which projects beyond it has its point passed through the membrana tympani, and then turned round so as to cause it to enter the tympanic cavity. When this has been effected, and a firm hold of the membrana tympani is secured, the canula is to be slightly unscrewed; an action by which its cutting extremity is pressed through the substance of the mem-

brana tympani and removes a circular portion. This instrument may be used, however, in cases where the sensibility of the tympanic membrane has been impaired by disease.

The usual method is, as stated, to puncture by the probe: and the part best adapted for this purpose is that between the handle of the malleus and the posterior margin.

The plan adopted by me for keeping open an orifice in the membrana tympani, and the particulars of a case in which it was practised, will be found below: it consists in making a triangular flap, by means of a very small scalpel, the blade of which is not more than two lines in breadth.

Case I. *Obstruction by thickened mucous membrane at the tympanic orifice.*—Miss K. J., aged 10, was brought to me on July 14, 1853.

History.—Between five and six years ago, after a cold, suffered from an attack of ear-ache, followed by dulness of hearing, so that she has been obliged to listen, in order to hear conversation. During attacks of cold, she has been so much worse as to require to be spoken to distinctly, within the distance of a yard or two. Is now subject to occasional attacks of ear-ache, and has had a slight discharge from the right ear. On *examination* of the *right ear*, the dermoid layer of the membrana tympani was white and thick, and covered with a small quantity of discharge; the membrana itself was more concave than natural; and the Eustachian tube was obstructed.

Left ear.—The surface of the meatus was covered with cerumen, having a natural appearance; the membrana tympani was white and concave; the Eustachian tube was obstructed; and the mucous membrane of the fauces was in a natural state.

Treatment.—Leeches were applied below each ear, twice a week, followed by blisters; and the one-thirtieth of a grain of the bichloride of mercury was given twice daily; a course of treatment which was pursued for six weeks. At first there was no improvement; after three weeks, however, a slight diminution of the deafness took place; and on the 1st of September, the hearing was quite restored, and the Eustachian tubes were pervious.

Case II. *Obstruction by thickened mucous membrane at the tympanic orifice, after influenza; polypus in one ear, a collection of cerumen in the other; great improvement.*—Master J. P. M.,

aged 14, in good health, was brought from Lincolnshire, July 27, 1853.

History.—Four years ago he had an attack of influenza, followed by so conspicuous a hardness of hearing, that he required persons to speak to him in a loud voice. During a cold, the deafness is much increased; at times, after a feeling of cracking in the ear, has heard much better. This crack occurred once in the right ear, after bathing, and was followed by perfect hearing for a few hours. The right ear has discharged blood for several months, and been affected with ear-ache. Previous treatment.—Glycerine has been dropped into both ears without any benefit; slight improvement followed the use of a blister behind each ear; tonics have been administered.

On *examination: right ear.*—Hearing distance, half an inch: the meatus contained a discharge, and at its inner part, concealing the membrana tympani, was a red, globular polypus. Eustachian tube obstructed. *Left ear.*—Hearing distance, half an inch: the meatus contained a collection of cerumen; on removal of which, the membrana tympani was seen to be very concave and white: Eustachian tube obstructed.

Treatment.—The polypus was extracted from the right ear by the lever-ring forceps; vesication was kept up over the mastoid processes; small doses of the iodide of potassium were administered. In the course of three months the hearing returned, and he remained well.

Case III. *Obstruction of the tympanic orifice of the tube; polypus in the right ear; cured.*—Miss M., aged 14, saw me on the 14th of February, 1854. Her health was good, but she complained of headache.

History.—During the last seven years has been, at times, dull of hearing, and has had attacks of ear-ache. During a cold is much worse. Has not had any discharge. Occasionally, after feeling as if something had burst in the right ear, had heard quite well for a short time. She now has to be loudly spoken to close to the right ear; the left is useless. On *examination*, the hearing distance of the *right ear* was found to be two inches; the membrana tympani was concave and white; the Eustachian tube obstructed. With the *left ear*, the crack of the nails was heard; the membrana tympani was thick; the Eustachian tube obstructed.

Treatment.—Brown's vesicating paper was ordered to be applied behind both ears every night, and three grains of hydrargyrum cum cretâ were to be taken every night.

March 7th.—The same: has not been pursuing the treatment with regularity; to take an emetic once a week, and the one-thirtieth of a grain of the bichloride of mercury, twice daily; the vesicating paper to be continued.

April 6th.—Has heard well for a week, and hears better to-day than on March 7th. A small vascular polypus is seen in the right meatus, near the membrana tympani.

May 11th.—The right ear has greatly improved; hearing distance, nine inches. Left ear: watch heard on pressure.

June 14th.—Right ear cured: the polypus has disappeared.

Case IV. *Obstruction of the tympanic orifice of the tube; temporary relief by puncturing the membrana tympani; cured by removing the obstruction.*—J. R., Esq., aged 53, strong, and in good health, was sent to me by Mr. Cock, on May 7th, 1853.

History.—When a boy was deaf, and was taken to Sir Astley Cooper, who punctured the drum of each ear; which operation was followed by complete relief until eight years ago, when, after a violent cold, deafness gradually came on in both ears; and has remained till now, with the exception of a day or two's improvement, at times, after violent sneezing. At present, he has to be loudly spoken to within a foot of his head, in which there is a feeling of constriction and of pressure on the top part. On *examination* of *right ear*, the crack of the nails only is heard; the membrana tympani is very opaque, uneven, and concave; Eustachian tube obstructed. *Left ear.*—Watch heard on pressure. Membrana tympani and Eustachian tube in the same state as in the right ear.

There was no doubt in my mind that the cause of the deafness was a thickened state of the mucous membrane at the tympanic orifice of the tube; and I prescribed the application of leeches below the ear, to be followed by blisters, while small doses of mercury were to be administered. The patient, however, implored me, if possible, to render him some immediate relief, as he was a candidate for a public appointment; for although my assurance that he would recover might favourably influence the committee, before whom he was to appear the following day, still he greatly feared that, should he not hear

what was said, he might be rejected. I therefore, but unsuccessfully, attempted to pass air into the tympanum through the catheter. I then punctured each membrana tympani with an ordinary probe, which, as it passed, conveyed the feeling of the membrane being soft and flaccid. The result was an instantaneous return of the hearing power, and the total disappearance of the weight in the head: to use his own words, he "felt free again." The hearing distance of each ear was six inches.

May 30th.—After the operation, continued to hear well until a few days ago, when the deafness slowly returned, and he is now nearly as deaf as on the 14th. The orifice in each membrana tympani had closed. As he was unable to wait until the remedies for opening the tube could be tried, I made a triangular flap, about two lines long, and a line broad below, in each membrane, by means of a scalpel, the blade of which was about two lines in breadth: the apex of the flap was above, and it was turned down. The result was as instantaneously favourable as in the previous operation; and as it was considered probable that the aperture would close, active treatment for the purpose of opening the tube was at once carried out. The consequence was, that in a fortnight, although the orifice in each membrana tympani had closed, the air passed freely through the Eustachian tube, and the patient heard well.

Closure of the tympanic orifice of the Eustachian tube by the effusion of fibrine will be spoken of when describing cases of the effusion of fibrine into the tympanic cavity.

(*d.*) OBSTRUCTION OF THE MIDDLE PART OF THE EUSTACHIAN TUBE; BY A COLLECTION OF MUCUS, BY A STRICTURE OF ITS CARTILAGINOUS OR OSSEOUS PORTIONS, OR BY BANDS OF ADHESION CONNECTING THE WALLS.

In the tabular view giving the result of 1523 dissections, it will have been observed that in thirteen instances the Eustachian tube contained mucus. In my opinion, however, a collection of mucus rarely offers insuperable resistance to the action of the muscles of the tube, to the pressure of the air in the fauces during the act of deglutition, or to an attempt at a forcible respiration, with closed nostrils, &c. It is nevertheless possible that in some of the cases where the tympanic orifice of the tube

is closed by thick mucous membrane, there may be also an accumulation of mucus: but as its presence would not require any alteration in the treatment, it is unnecessary to dilate upon the subject.

Stricture of the osseous portion of the Eustachian tube is very rare. Only one case has fallen under my observation; but as I had the opportunity of seeing the patient during life, and afterwards of making a dissection of the ear, it is of sufficient interest to be detailed at length.

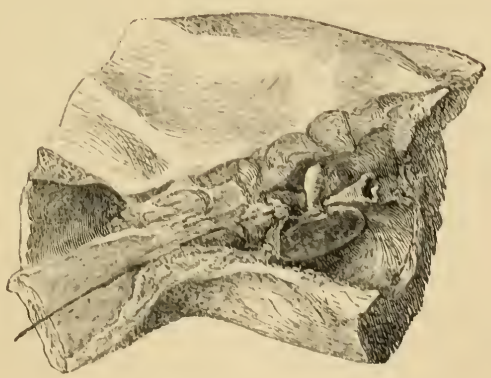
Case I. *Stricture of the osseous portion of the Eustachian tube; dissection.*—C. J., aged 45, was visited by me in the month of November, 1849. He was dying from tubercular disease, so that I was precluded from making so minute an examination as would have been desirable. The *history* of the origin and progress of the deafness, as far as could be ascertained, was as follows:—About twenty years ago, the patient suffered from a violent inflammation in the right ear, followed by a discharge from the external meatus, which had continued almost without intermission up to the time he was seen by me. For a considerable period this ear had been unable to distinguish sounds, and the left ear had been gradually growing less and less sensitive to sonorous vibrations during the preceding six or seven years. No pain had been felt in it, however, and there had been no discharge from the external meatus.

Upon inspection by means of a speculum and lamp, the membrana tympani of the *right ear* was observed to be absent, while the mucous membrane lining the tympanic cavity was very thick, and covered by a large quantity of purulent matter. In the *left ear*, the lining membrane of the external ear was slightly reddened, and the membrana tympani was as white as writing paper; while the handle of the malleus, usually so distinctly seen, could not be distinguished from the surrounding membrane. Towards its centre, the surface of the membrana tympani had lost the natural shining appearance; but a small portion of its surface, on each side of the handle of the malleus, although perfectly white, was so smooth as to reflect the light of the lamp. As the patient was in a state of great debility, the otoscope was not applied to either ear to test the condition of the Eustachian tube. The patient died a few days after the examination.

Post-mortem inspection. Right ear.—The mucous membrane lining the tympanic cavity was thick and in parts ulcerated; while the bone forming the upper wall of the cavity, with which the ulcerated membrane was in contact, was carious. The Eustachian tube was healthy.

Left ear.—The central portion of the membrana tympani was found to be white and thick; but those parts of it which lie anteriorly and posteriorly to the handle of the malleus, were soft and attenuated, and the white appearance was due to the presence of mucus in the tympanic cavity, in immediate contact with the inner surface of the membrana tympani. So softened was this portion of that membrane, that on applying the slightest pressure, the fibres composing it gave way, and three small orifices were produced. The cavity of the tympanum and the mastoid cells were filled with thick, white mucus, and no air was discoverable. The mucous membrane lining the cavity was also thicker than natural.

The Eustachian tube.—The internal portion for the length of half an inch was healthy; but at about that distance from the cavity of the tympanum, there was a sudden constriction, and for the length of about a line and a half the tube was so contracted, that, even when its superior wall was removed, it was with difficulty that an ordinary-sized bristle could be introduced



STRICTURE OF THE EUSTACHIAN TUBE. THE BLACK BRISTLE IS SEEN PASSING FROM THE TYMPANIC CAVITY THROUGH THE STRICTURED PORTION.

into the opening. This stricture resulted from the external and internal walls of the tube pressing against each other; the small space still permeable being at the upper part. The more

remote cause of the stricture would appear, however, to have been an enlargement of portions of the bone constituting the external and internal osseous walls of the tube: the former being at this part twice its natural thickness, and somewhat rough, while the latter was forced outwards by the dilatation of the carotid canal, which, pressing thus upon the cartilaginous portion of the Eustachian tube with which it was in contact, produced a flattening of the natural concavity of the internal wall. The mucous membrane lining the Eustachian tube was in a natural state.

Although three dissections are recorded of adhesion between the walls of the tube by means of membranous bands, I have not hitherto met with a case during life. In such an instance the treatment would consist in puncturing the membrana tympani, and establishing an orifice in it.

CHAPTER XII.

THE CAVITY OF THE TYMPANUM.

ANATOMICAL OBSERVATIONS—PATHOLOGICAL OBSERVATIONS—DISEASES OF THE MUCOUS MEMBRANE:—*a*, CONGESTION. *b*, ACUTE INFLAMMATION—AFFECTING THE PORTIA DURA NERVE—EXTENDING TO THE BRAIN—SCROFULOUS MATTER IN THE TYMPANIC CAVITY. *c*, CHRONIC INFLAMMATION. *d*, CHRONIC CATARRHAL INFLAMMATION. *e*, CHRONIC CATARRHAL INFLAMMATION EXTENDING TO THE BONE, DURA MATER, OR BRAIN. *f*, ULCERATION OF THE MUCOUS MEMBRANE.

Anatomical observations. — The tympanic cavity is lined throughout by a fine membrane, which forms the internal layer of the membrana tympani, and from which it can sometimes be detached without difficulty. Internally it covers the surface of the promontory and the membrana propria of the fenestra rotunda; it is reflected from the promontory at the circumference of the fenestra ovalis upon the surface of the stapes, and it envelopes the incus and malleus, by means of which it is continuous with the inner layer of the membrana tympani; above and below that membrane it covers the osseous walls of the tympanum, and is prolonged posteriorly into the mastoid cells, while anteriorly it is continuous with the lining membrane of the Eustachian tube. The mucous membrane of the tympanic cavity, in a healthy ear, is so extremely thin as to be quite transparent; and its presence upon the surface of the osseous walls and ossicles of the tympanum, can often only be detected by the use of a magnifying glass and by the touch. In a natural state the nervous filaments upon the surface of the promontory are very distinctly seen, the margin of the fenestra rotunda is defined and regular, and the membrane which occupies it is thin and transparent. The crura of the stapes, as well as their point of connexion with the base, are clearly seen, and a distinct fissure is observable between the inferior surface

of the crura and the promontory. The quantity of mucus covering this membrane in a healthy ear is so small as to be scarcely perceptible. The membrane itself is composed of extremely fine and delicate fibres, and it has a strong analogy with the serous membranes: first, in respect to its extreme tenuity and great smoothness; second, in the frequency with which membranous bands connect together various parts of the tympanic cavity. Over its surface extends a layer of very minute epithelial cells, some of which are ciliated. The supply of blood-vessels is abundant, though they are so minute as not to be discernible, except when distended with blood: this happens in disease, and then they are often very much dilated and surcharged. In young persons the membrane is highly vascular, and, when successfully injected, is found to be pervaded by plexiform ramifications. Beneath the mucous membrane lie the branches of the tympanic nerve from the glosso-pharyngeal.

The upper wall of the tympanum is formed by a layer of bone which separates the tympanic cavity from that of the cerebrum, and which deserves special attention, inasmuch as the diseases of the tympanum, which affect the brain, usually advance through that bone. Its form is an elongated oval, and it

AN ANTERO-POSTERIOR VERTICAL SECTION OF THE TEMPORAL BONE THROUGH THE TYMPANIC CAVITY AND MASTOID CELLS.

measures about three quarters of an inch long and from a quarter to half an inch in breadth. Its direction is obliquely inwards

and forwards, like that of the petrous bone. Externally it is attached to the lower part of the squamous, and internally to the outer part of the petrous, bone: anteriorly it is continuous with the roof of the Eustachian tube, and posteriorly with the roof of the horizontal portion of the mastoid cells. This osseous lamina, forming the upper wall of the tympanum, varies much in thickness, being in some instances from half to an entire line thick, though more frequently it is very thin, presenting a mere shell of translucent bone. In many specimens this lamina is deficient in parts, and the mucous membrane of the tympanum is in contact with the dura mater covering the petrous bone. In some specimens in my possession, the head of the malleus projects through an orifice in this portion of the bone, and was directly covered by the dura mater. This defect in the upper wall of the tympanum is not usually the result of disease, but of the process of development. In the specimen, of which the following is a representation, the horizontal lamina alone is

THE UPPER OSSEOUS WALL OF THE TYMPANUM DEFECTIVE.

absent, while the vertical septa extend upwards, even above the surrounding surface.

It has been thought desirable to be thus particular in the description of the relations of the tympanum, because frequent reference is made to the description in the pathological details subsequently entered into.

Pathological observations. — The diseases of the tympanic cavity are numerous and important. Perhaps the most common affection to which the organ of hearing is subject, is a greater or less degree of thickening of the tympanic mucous membrane, with or without catarrh through the membrana tympani. Besides this affection, a simple accumulation of mucus in the tympanic cavity is of great frequency; and, finally, anchylosis of the stapes to the fenestra ovalis is a most common disease.

The diseases of the tympanic cavity, as revealed by the dissection of 1013 diseased ears, are as follow:—

CONTENTS.

Mucus	65
Blood	6
Blood and mucus	1
Blood, mucus, and lymph	1
Serum	10
Serum and mucus	3
Serum and lymph	1
Lymph	6
Epithelium	2
Epithelium and oil	1
Scrofulous matter	20
Calcareous matter	8
Cerumen	1
Cholesterine	1
Cholesterine and mucus	5
Cellular tissue	2
Oily matter	1
Pus	17

STATE OF THE MUCOUS MEMBRANE.

More vascular than natural	75
Thicker than natural	211
Thick and very vascular	16
So thick as to conceal the stapes	27
So thick as to fill the tympanic cavity	6
Ulcerated	24
Pulpy	5
Containing black pigment cells	2
Having serum beneath it	1

MEMBRANOUS BANDS BETWEEN

Malleus and promontory	6
Malleus, incus, and promontory	1
Malleus and stapes	1
Malleus, stapes, and promontory	6
Incus and promontory	5
Incus, stapes, and promontory	3
Incus and malleus	1
Stapes and promontory, the mucous membrane being healthy	79
Stapes and promontory, the mucous membrane being thick	48
Stapes and promontory, the mucous membrane being vascular	6
Stapes, promontory, and pyramid	1
All the ossicles	30
All the ossicles and the promontory	9
Tensor tympani muscle (the tendon) and the stapes	3
Chorda tympani nerve, incus, stapes, and promontory	2
Chorda tympani nerve and upper wall of tympanum	1

MALLEUS.

Adherent to the promontory	1
Absent, apparently from caries or ulceration	4
Partly removed by caries	1
Malleus and incus lying in the mastoid cells	1
Fixed by ligamentous anchylosis to the upper wall of the tympanum	3
Fixed by osseous anchylosis to the upper wall of the tympanum	2
The body anchylosed to the incus	3
The long process detached from the membrana tympani	3
The long process fractured	1
The long process in contact with the promontory	3
The long process adherent to the incus	1
The long process detached from the body	1
The long process absent	2
The long process carious	3
The long process exostosed	1

INCUS.

Absent	4
Long process absent	2
Partly removed by caries	8
Disconnected from stapes	14
Disconnected from stapes and malleus	1
Fixed by membranous anchylosis to the orifice of the mastoid cells	2

STAPES.

The base anchylosed by bone to the fenestra ovalis	49
The base anchylosed by bone to the fenestra ovalis, the base being expanded	6

The base anchylosed by membrane to the margin of the fenestra ovalis	36
The base anchylosed by membrane to the margin of the fenestra ovalis, the base being expanded	6
The base anchylosed by membrane to the margin of the fenestra ovalis, an exostosis surrounding the fenestra	2
The base of the stapes attached to the fenestra ovalis more rigidly than natural	66
The base projecting into the cavity of the vestibule	5
The base expanded and more fixed than natural	7
The base expanded and projecting into the vestibule	2
Detached from incus and attached to the membrana tympani	1
Anchylosed to incus	2
Detached from the fenestra ovalis and the incus	2
Disconnected from the fenestra ovalis	1
Partially absorbed	1
Atrophied	1
Absent, apparently from ulceration	2

ALL THE OSSICLES.

Less movable than natural	4
Absent, apparently from ulceration	2
Disconnected from each other	1
Carious	2

OSSEOUS WALLS.

Thickened	1
Carious	6
Upper wall partly deficient	54
Lower wall partly deficient	25
Osseous lamina between mastoid cells and lateral sinus incomplete	2
Osseous lamina between mastoid cells and cavitas cerebelli incomplete	1
Canal for portio dura nerve incomplete	2
Carotid canal contracted	7

Upon reference to Mr. Hinton's valuable Paper on the Pathology of the Ear, published in the Thirty-ninth Volume of the "Medico-Chirurgical Transactions," it will be found that the results at which he has arrived, agree with those quoted above.

The plan I purpose to follow in investigating the subject will be to consider successively the affections of the mucous membranes, and those of the ossicles.

(*a.*) CONGESTION OF THE MUCOUS MEMBRANE OF THE TYMPANUM.

Congestion of the tympanic mucous membrane usually follows a cold, or an attack of influenza. The symptoms are a feeling of deadness in the ears, sounds like the ringing of bells, dulness of hearing, and not unfrequently slight pain. If neglected, this affection is liable to advance to acute inflammation. It frequently accompanies congestion of the mucous membrane of the fauces and of the Eustachian tubes. On *examination,* the surface of the membrana tympani is sometimes observed to be very shining, and in other cases opaque. The hearing power is but slightly diminished. The *treatment* consists in applying leeches below the ears, and using gentle counter-irritation over the mastoid processes. The symptoms commonly yield in a few days.

Case I.—Mrs. B., æt. 40, was sent to me by a medical man in 1853. She enjoyed good health.

History.—Has not suffered from any affection of the ears until a fortnight since, when, subsequently to an attack of cold, a feeling of numbness, and a sound as of the ringing of bells, supervened in both ears. There was also, at times, a shooting pain in the right ear. On *examination,* the mucous membrane of the fauces was observed to be red.

Right ear.—The membrana tympani was rather more opaque than natural; the hearing power natural; the Eustachian tube pervious.

Left ear. — Membrana tympani opaque; hearing distance three inches; Eustachian tube pervious.

Treatment.—Slight counter-irritation, by means of a stimulating liniment, was kept up over and around each ear, and in the course of ten days the symptoms were wholly removed.

Case II.—Mrs. P., æt. 73, consulted me in July, 1853.

History.—Six weeks previously had an attack of influenza, which was succeeded by considerable pain in the right ear, followed by a sensation of "pumping" in the ear, which has continued to the present time: recently deafness of that ear has been complained of, and the voice appears to come out of the ear.

On *examination,* the membrana tympani and Eustachian tube appeared to be normal; but the hearing power was so diminished that the watch was heard only when pressed upon the ear.

Treatment.—A leech was applied below the ear, and the

symptoms abated; counter-irritation was then resorted to, and by degrees all unpleasant sensations vanished.

(*b.*) ACUTE INFLAMMATION OF THE MUCOUS MEMBRANE OF THE TYMPANUM.

I have not hitherto been enabled to distinguish between acute inflammation of the mucous membrane of the tympanum and that of its fibrous membrane, the periosteum, which is subjacent to it. When the delicacy of these membranes is taken into consideration, and their intimate union so as to form one membrane of such extreme tenuity that its presence in the healthy ear can only be detected by the closest examination, it would be a source of surprise if acute inflammation were to attack either of these structures without involving the other; although in many cases doubtless one of them is more specially implicated. In the description of acute inflammation of the mucous membrane of the tympanum, the periosteum will therefore be included by me, especially as the symptoms to be detailed appear to indicate that the view just advanced is correct. If the mucous membrane of the tympanum be examined during an attack of acute inflammation, an opportunity for which is sometimes afforded when a patient suffering from this affection dies of some other disease, the blood-vessels are so large and so numerous, that upon a cursory inspection the membrane seems as if it were covered by a layer of dark coloured blood. On more accurate inspection, however, it is observed that this blood is confined to the cavity of the vessels, and that the latter are completely distended in every part.

The exciting cause is usually exposure to a draught of cold air, or sudden change of temperature. In its milder form this affection is met with in children, and known as ear-ache; for although the paroxysms of pain are often very severe, the symptoms are generally confined to the ear, and do not produce much constitutional disturbance. In children it is evident that the mucous membrane is more affected than the periosteum; and perhaps one cause of the comparative mildness of the affection in the young, is, that the tympanic fibro-mucous membrane is laxer and more extensible than in the adult.

In children attacks of acute inflammation of the mucous membrane of the tympanum are apt to be greatly neglected, and consequently they frequently recur in the same child; and

even if they do not at the time produce a serious lesion of the membrana tympani or obstruction of the Eustachian tube, they probably lay the foundation of deafness in after life, by causing a permanent thickening and rigidity of the membrane: membranous anchylosis of the stapes seems also to originate in this manner. When called to see a child suffering from inflammation of this membrane, a medical man will generally find that the membrana tympani is very smooth and shining, and more or less red in colour, according to the degree of distension with blood of the vessels of the mucous membrane forming its inner layer. Sometimes this latter membrane has become thickened, giving a sodden appearance to the membrana tympani; a condition liable to occur also when the tympanic cavity contains an accumulation of mucus. It commonly happens that in children the chief pain is felt at night, when the recumbent position and the heat of the pillow favour the congestion of the membrane. Although the child may not complain of pain in the day-time, and when seen by the surgeon may even be cheerful, still, should any appearance of congestion remain, or, tested by the watch, any dulness of hearing, it is important to apply one or two leeches below the ear, and to keep up a slight discharge behind it.

In the adult, this affection is usually of a much more formidable nature, and it sometimes has a rheumatic or gouty character. The first symptom is a sense of uneasiness in the ear, which becomes pain during motion, pressure on the organ, the act of deglutition or the use of the pocket-handkerchief. This uneasiness soon amounts to continuous pain, which, in severe cases, rapidly increases until it becomes so intense as to be scarcely endurable; and extends over the mastoid process, the whole of the affected side of the head, down the neck, and into the fauces. The power of hearing rapidly diminishes, and a variety of the most horrible sounds are experienced; sometimes described as like the hissing and puffing of a steam-engine, varied by others like a series of explosions in the ear, or the ringing of bells. A symptom of this affection which adds greatly to the suffering of the patient, is the impairment of the functions of the brain; sometimes amounting only to a confusion of ideas, frequently accompanied by extreme fear and depression of the nervous system, causing the worst forebodings as to the result of the attack; in other cases delirium super-

venes, and in the most formidable cases death takes place, from the inflammation extending to the membranes of the brain. Where only some of these symptoms, and those of a less violent character, are present, the surgeon may doubt whether the affection is in the tympanic cavity or in the meatus. An examination of the ear with the speculum and lamp will decide the question; for in the affection under consideration, there is no appearance of inflammation in the dermoid meatus or the membrana tympani. The modes in which this affection terminates are the formation of lymph; the effusion of serum into the tympanic cavity, which escapes through the Eustachian tube into the fauces; or a copious secretion of pus or mucus, which distends the tympanum, causes ulceration and perforation of all the laminæ of the membrana tympani, and ends in abundant discharge. In some cases there is no indication of any secretion occurring in the tympanum, and the affection seems to terminate by resolution; in others the dermoid meatus pours out a sympathetic discharge without the presence of any orifice in the membrana tympani. The prognosis in cases of this disease is favourable, and it is a great consolation to the patient to be assured, amidst the very distressing symptoms from which he suffers, that no permanent injury need be apprehended. It would appear that a single attack of inflammation of the fibro-mucous membrane of the tympanum, however violent it may be, does not leave behind it that rigidity and dulness of hearing which is a sequence of the attacks of a milder character occurring in children. When an orifice forms in the membrana tympani, it usually closes without difficulty; and the power of hearing is in two or three weeks completely restored. In some, but fortunately rare cases, the inflammation extends to the petrous bone, and thence to the membrane of the brain, causing death. It not unfrequently happens, however, that the inflammation extends to the portio dura nerve in the aqueduct of Fallopius, and partial or complete paralysis of that nerve is the result; which is removed as soon as the inflammation has wholly subsided.

The *treatment* of this affection consists, in the first place, of the local abstraction of blood by leeches or cupping; the leeches being applied at the orifice or behind the ear, and the cupping practised directly below it. Leeches may also be applied to the

nostrils. Vapour baths should frequently be applied to the ear, so as to allow the steam to penetrate as far as the membrana tympani. The throat should be repeatedly gargled with hot water. The patient is to be kept perfectly quiet, as the least excitement or exercise is apt to aggravate the symptoms materially; the room should also be darkened, and every sound excluded as much as possible. The use of mercury will be found very efficacious, especially when combined with full doses of opium or morphia. When the pain is very intense, it is desirable to keep the patient for several hours under the influence of opium. In the early stages of the affection tartar emetic proves advantageous. As soon as the discharge appears, the meatus should be gently syringed with a copious supply of warm water, thrice daily.

In children the treatment may usually be less active; but it is important to try the application of leeches and counter-irritants, thoroughly to subdue the inflammation as rapidly as possible.

Case I. *Acute inflammation of the mucous membrane of the tympanum; perforation of the membrana tympani.*—C. C., aged 40, sent for me in November, 1852, on account of a severe attack of pain in the right ear.

History.—Two days previously he had been exposed to a cold wind, which was followed towards night by pain in the ear. During the night the pain became much aggravated, and seemed not only to be in the ear, but to extend over the whole of the side of the head, and especially over the region of the mastoid process. There was also great constitutional disturbance, confusion in the head, and the most extraordinary noises. "At the same moment," said the patient, "I seemed to be standing at the side of a steam-engine, snorting, puffing, and hissing, and yet hearing the sound of a church-bell tolling at a distance."

On examining the ear, the membranous meatus was observed to be red, the membrana tympani dull and opaque. The patient was very excitable; pulse quick; skin hot. Leeches were ordered to be applied immediately below and at the back of the ear, to be followed by hot fomentations and poultices. Calomel and opium were administered. Under this treatment, with the addition of a blister to the nape of the neck, in three days the symptoms gradually subsided. At the end of the third day,

while the head was on the pillow, a feeling as of something bursting in the ear was experienced. This was followed by a discharge from the ear, and a considerable additional relief to the pain. On further examination, a small orifice was detected in the lower part of the membrana tympani, through which viscid mucus escaped from the tympanum. There was also great dulness of hearing, which was the more distressing to the patient from his having lost the use of the other ear during childhood. The perforation was regarded by me as a favourable symptom, being likely to prevent the formation of membranous bands in the tympanic cavity. The inflammation slowly subsided; the aperture in the membrana tympani closed; and, in the course of ten days, the patient heard as well as before the attack. His hearing has since continued good.

In some cases of acute inflammation of the mucous membrane of the tympanum, the pain in the ear is not so violent as in the case just detailed; but the symptoms of cerebral disturbance are more distressing and continuous. One reason for the cases of less active inflammation assuming the chronic form, seems to me to be, that a much smaller quantity of mucus being secreted, the membrana tympani does not give way. The consequence is, the mucus collects by degrees in the tympanic cavity, and thus keeps up a constant, though slight, irritation. In these chronic cases the symptoms often disappear after a discharge from the ear; and careful inspection shows that there is no perforation of the membrana tympani, and that the discharge does not originate from the tympanic cavity, but has its source in the dermoid meatus; being the result simply of the irritation of the tympanic mucous membrane.

The following case will illustrate the preceding remarks.

Case II. *Acute inflammation of the mucous membrane of the tympanum; prolonged pain in the head; discharge from the meatus; relief.*—M. A. K., aged 26, was admitted under my care in St. Mary's Hospital on October 6th, 1854.

History.—About a month ago she complained of pain in the face and soreness of the throat, together with pain in the right side of the head. These symptoms were followed by deafness in the right ear. At the time of admission she complained of pain and throbbing in the right ear, extending inwards down the throat. On *examination*, the tongue was found slightly

furred, the pulse 84 and small. The surface of the meatus was red, and the vessels of the dermoid layer of the membrana tympani were distended. The crack of the nail was heard when made close to the ear. Air passed into the tympanic cavity.

Treatment.—Leeches were applied below the ear; and an evaporating lotion around it.

October 12th.—Pain much the same. To repeat the leeches and take half a grain of the chloride of mercury, and a quarter of a grain of opium every night.

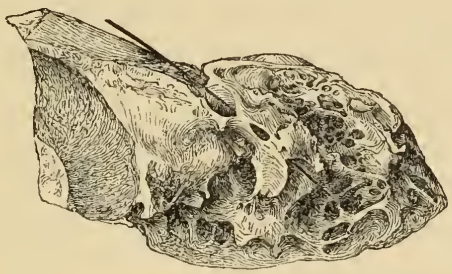
October 16th.—Pain somewhat less, but still severely felt deep in the ear.

October 20th.—To repeat the leeches.

October 24th.—Much better; has had an abundant discharge from the ear, followed by immediate cessation of the pain. On inspection, it was seen that the discharge had issued from the surface of the meatus; and there was no perforation of the membrana tympani.

October 28th.—The pain has totally disappeared.

1. *Acute inflammation affecting the portio dura nerve.*—It is well known that the portio dura nerve passes through the aquæduct of Fallopius along the upper and posterior wall of the



THE CANAL FOR THE PORTIO DURA NERVE AT THE UPPER PART OF THE TYMPANIC CAVITY INCOMPLETE. A DARK BRISTLE IS PASSED THROUGH THE CANAL.

tympanum; but it not unfrequently happens that the inner osseous wall of this canal is incomplete, and thus the mucous membrane of the tympanum is in contact with the outer surface of the nerve. In cases of acute inflammation of the tympanic mucous membrane, therefore, the nerve often becomes affected, either by the prolongation of the inflammation from the mucous membrane directly to the nerve, or through the wall of the

canal. In some of these cases the membrana tympani ulcerates, and there is a copious discharge from the tympanic cavity; in others it remains intact.

Case III. *Acute inflammation of the mucous membrane of the tympanum; ulceration of the membrana tympani; paralysis of the portio dura nerve; cure.*—E. I., aged 23, was admitted under my care, at the St. George's and St. James's Dispensary, on February 28th, 1843.

History.—He stated that three months previously he was suddenly seized with a violent attack of pain in the right ear, which extended over the side of the head. After the pain had lasted for about twenty-four hours, he experienced a sensation of something bursting in the ear, followed by an abundant thick and offensive-smelling discharge. During the attack of pain he had much giddiness, lost the use of the right side of the face, and could not shut his right eye, while the mouth was drawn to the left side. On *examination,* an orifice was observed in the right membrana tympani; the mucous membrane of the tympanum was red and thick, and poured out a mucous discharge. He was ordered to apply a blister behind the ear, and became better, having no return of the pain till March 11th, when it suddenly reappeared in great violence, accompanied by a singing and by sensations of pumping and throbbing in the ear. These symptoms were much aggravated by coughing. The discharge was abundant, and the mucous membrane of the tympanum very red. Leeches were applied below the ear, which was often syringed with warm water; and after the pain was somewhat subdued, a blister was applied behind the ear. Calomel and opium were administered until the gums were rendered tender. The symptoms gradually subsided.

April 11th.—Improved, and complains of but little pain.

April 16th.—The discharge is much diminished; the orifice in the membrana tympani is smaller; and the singing noise not so loud. He cannot yet close the right eye or use the mouth freely, but the power over the muscles of the face is certainly greater. Ordered to rub the ointment of tartarized antimony behind the ear. From this time the patient gradually improved, and on the 3rd of July the portio dura nerve had regained its power, and the quantity of discharge had much diminished.

The following case of the same kind occurred in a younger person.

Case IV. *Acute inflammation of the mucous membrane of the right tympanum; great pain in the head; temporary paralysis of the right portio dura nerve.*—Master S., aged 5, pale and weakly, was brought to me on the 10th of February, 1850.

History.—Three months previously, the right ear had been pulled rather violently. Fourteen days ago, he complained of pain deep in the right ear, which in two days was followed by discharge and relief. Lately he has so suffered from pain on the right side of the head, that he constantly presses it with his hand; and for a week he had paralysis of the right side of the face: but perfectly recovered. To-day he again complains of pain in the ear. On *examination* of the right ear, the surface of the meatus was observed to be red and swollen, denuded of epidermis, and covered by a thick white discharge; the membrana tympani, which was in the same state, bulged outwards. Leeches below the ear, the use of warm fomentations, and the administration of tonic medicines, speedily reduced the pain in the ear and head, and he was sent to the sea-side. On March 7th, about a month after I had first seen him, I found that the matter had made its way through a small orifice in the lower part of the membrana tympani.

In some cases, the portio dura nerve becomes affected while the patient is under treatment for secondary syphilis. Two instances of this kind have occurred to me. In one, the patient was a man of twenty-three, who stated, that six months previous to his consulting me, he had complained of pain in his left ear for two or three days, when he suddenly lost the use of the left side of the face, and found that he could not close the left eye. On *examination*, the left membrana tympani was rather opaque, although its surface was smooth. On swallowing with closed nostrils, and in forcing the air, it passed freely into the right tympanic cavity, but not so freely into the left. The patient was treated with small doses of iodide of potassium, and by the application of ointment of tartarized antimony behind the ear. After six weeks of this treatment, there was scarcely any trace of the paralysis of the muscles of the face, and the hissing sound had greatly diminished; but the deafness remained as before.

2. *Acute inflammation extending to the brain.*—In some cases, the inflammation advances from the tympanic cavity to the brain, and death is the consequence. The following illustrative case is taken, in an abridged form, from Itard.*

Case V. *Acute inflammation of the mucous membrane of the tympanum; inflammation of dura mater; death.*—J. B., aged 26, of a sanguine temperament and robust constitution, was received into the military hospital of Val de Grace, on account of an inflammation of the pleura. On the fifth day of the attack he was seized with violent pain in both ears, but especially in the left, and the pain was accompanied by a rushing noise like that of a torrent. On the sixth day the pain increased so as to become intolerable, with throbbing in the ears; pain in the head violent, pulse hard and full. These symptoms increased, with great excitement, delirium, and stupor, and the patient died on the seventh day.

On dissection of the right ear, the mucous membrane of the tympanum was red, swollen, velvety, and covered by puriform mucus, of which the cavity was full. The membrana tympani was entire, but its inner layer very thick and red. The mastoid cells were full of mucus. In the left ear, where the pain had been the most acute, the mucous membrane of the tympanum and mastoid cells was of a deep red colour, but there was no secretion of mucus. The dura mater covering the anterior and posterior surfaces of the petrous bone was adherent to the adjacent cerebral substance; it was red, and thick, and separated from the bone. Between the bone and the dura mater, there was nearly half an ounce of a transparent gelatinous fluid.

A case somewhat similar to the foregoing, I had an opportunity of inspecting, after death, with Dr. Blakely Brown.

Case VI. *Acute inflammation of the tympanic mucous membrane after whooping-cough; dura mater inflamed: effusion of serum between it and the petrous bone, and in the lateral ventricles.*—The child was three years old, and shortly before the fatal seizure had gone through an attack of whooping-cough. A year and a half previous to her death, she had a discharge from the left ear, at first unaccompanied with pain, but subsequently, at times, she suffered from acute attacks of pain in the ear and side of the head, previous to, and during which, the discharge

* Traité des Maladies de l'Oreille. Vol. i. p. 193 *et seq.*

subsided. A few days before her death, one of these attacks of intense pain in the ear and head came on, and resisted every remedial measure prescribed, until the child died in the greatest suffering.

On *inspection*, it was found that the whole of the membrana tympani had been destroyed, with the exception of a small semi-lunar margin at the upper and posterior part. The mucous membrane lining the tympanic cavity was of a deep red colour, from its blood-vessels being enlarged and distended with blood. The dura mater was much congested; serum was effused between it and the petrous bone, and its inner surface was adherent to the arachnoid. Serum was also effused beneath the arachnoid, and in the lateral ventricles.

In cases of *typhus fever*, I have found the dura mater partaking of the inflammation of the tympanic mucous membrane. One case of this kind was that of a girl, aged 16, who died of *typhus fever*, after seven weeks' illness. She was, to a certain degree, dull of hearing from the commencement of the attack, but not previously.

Dissection. Right ear.—The meatus externus contained a large quantity of thick matter, and the dermis and periosteum were so soft as to be easily detached from the bone. The membrana tympani had been removed by ulceration. The tympanic mucous membrane was thick and soft, and, although the ossicles were in their natural position, the long process of the malleus had been absorbed. The cavity contained thick mucus; and the dura mater was detached from the upper part of the tympanum.

Left ear.—The meatus was full of pus; its lining membrane was soft, and a small strip only of the membrana tympani remained. The tympanum and mastoid cells were full of thick muco-purulent matter; the lining membrane being thick, soft, and disconnected from the bone. The dura mater adhered so slightly to the upper wall of the tympanum, that it was disengaged by the gentlest traction.

In other cases of death from *typhus fever*, I found the dura mater inflamed, and separated from the upper surface of the petrous bone by serum. In one case, that of a patient aged 17, during the attack of fever, but not previous to it, there was great dulness of hearing for nine days, and discharge from the

left ear four or five days prior to death. On dissection, the dura mater was found to partake of the inflammation of the mucous membrane; the bone was also very vascular, and it was separated from the dura mater by a small quantity of serum.

The presence of *scrofulous matter in the tympanic cavity* sometimes gives origin to the most formidable cerebral symptoms, and, in some cases, without leaving any traces of inflammation of the brain after death. In the following case, which occurred under the care of Dr. Chambers, in St. Mary's Hospital, and which I had the opportunity of seeing during life, I think there is no doubt but that the cerebral symptoms arose from the affection of the ear.

Case VII. *Accumulation of scrofulous matter in the tympanum; acute inflammation of the mucous membrane; severe cerebral symptoms; death.*—S. B., aged 10, was admitted into St. Mary's Hospital on the 21st April, 1854, with the following history:—Vomiting, heat of skin, headache; occasional shrill screaming had commenced on the 18th, and continued to the time of admission. The bowels had not acted since the 19th. She had formerly a discharge from the right ear; but that had latterly ceased, though deafness remained.

On *examination*, the pulse was rapid and regular; the skin hot and dry; the face flushed; the eyes heavy but shiny; the pupils naturally affected by light. There was a tendency to a sort of comatose sleep, but she was easily roused by speaking to her.

April 21st.—Ten leeches to be applied to the head; also ice; one and a half grain of calomel every hour, and a purgative in the morning.

22nd.—Urine albuminous, probably from the calomel. No more vomiting. Bowels opened several times. Complains of pain in the cardiac region. Keeps boring her head into the pillow, and occasionally screaming. No pain in the head. Tongue white and furred; pulse 108, regular; one of the evacuations was mucous and bloody, the rest dark. Ordered the calomel every three hours, and a blister to the nape of the neck.

23rd.—The same symptoms exaggerated, with violent delirium occasionally and screaming, alternating with a half comatose state. This continued till her death, at two in the morning of

the 25th, the face and lips remaining flushed till the time of decease.

Post-mortem inspection.—The tympanic cavity contained scrofulous matter. The mucous membrane lining the tympanic cavity was very red, and its blood-vessels very distended. The whole of the petrous bone and the dura mater covering it, was also of a deep red colour, from the distension of the vessels.

(*c.*) CHRONIC INFLAMMATION AND HYPERTROPHY OF THE TYMPANIC MUCOUS MEMBRANE.

I am not sure that the above designation is perfectly correct, because it appears probable that hypertrophy of the mucous membrane sometimes takes place without the occurrence of any appreciable inflammatory symptoms; indeed, in children having a tendency to glandular enlargements, the mucous membrane appears to become thickened without the slightest sign of inflammation. In some cases, however, chronic inflammation undoubtedly precedes the hypertrophy.

Pathological observations.—The mucous membrane lining the tympanic cavity, frequently undergoes the process of hypertrophy. This delicately thin mucous membrane, so fine in its natural state as often to require the aid of touch as well as sight to determine its presence, may nevertheless become so thickened as to fill the whole, or nearly the whole of the tympanic cavity. From being like a piece of the finest silver paper, it becomes more like velvet. Instead of throwing out just so much mucus as suffices to lubricate the surface of the membrane, it pours forth a thick and viscid secretion which often fills up the entire cavity unoccupied by the hypertrophied lining. In some cases where the Eustachian tube is partially or wholly closed by the hypertrophied membrane, the mucus presses upon the inner surface of the membrana tympani; gradually by its pressure causing absorption, and ultimately produces an orifice through which the mucus escapes into the meatus, giving rise to what was formerly called a case of otorrhœa. This discharge through an orifice in the membrana tympani, in the way just described, is one of the common results of scarlet fever; and though it does not appear probable that the mucous membrane should become hypertrophied in so short a space of time as that in which a

case of scarlet fever is developed, yet it is still possible that it may be so. My belief, however, is, that in these cases of catarrh of the mucous membrane, hypertrophy has usually preceded the attack of fever; and that this condition of the tympanum and other organs are evidence of a weakened state of the system. Sometimes this condition of chronic inflammation of the mucous membrane extends upwards through the osseous wall, and affects the dura mater. The constant attacks of ear-ache in some children are due to this affection.

The *predisposing cause* is the most essential point to ascertain in respect to this affection, since it almost invariably occurs in those whose vital power has been lowered by disease, or some other debilitating influence. Improper food or clothing, insufficient ventilation or exercise, or some analogous cause, may almost always be detected; and when detected, should be at once removed, if possible, or at least diminished by the skill of the surgeon; after which, the next step is to assist in remedying the effects. It will usually be observed, on general examination, that the child is pale, flabby, deficient in bodily strength and spirit, with the submaxillary, or cervical glands, often hypertrophied, and the heart weak. On inspecting the ear, the dermis of the meatus is commonly thicker than natural, so that the calibre of the meatus is diminished, and there is some difficulty in obtaining a distinct view of the membrana tympani; but when the latter organ, or a portion of it, is seen, its surface is found to be less shiny than natural, and not unfrequently of a whitish colour, resembling the appearance of parchment more or less sodden. Sometimes, while the long process of the malleus is unseen, the *processus brevis* stands out prominently. When the Eustachian tube is also obstructed, the membrana tympani is externally much more concave than natural. On exploring the tympanic cavity by the otoscope, air is not unfrequently heard most distinctly to enter the cavity, although the sounds developed by its entrance are abnormal. Instead of the normal crackling, a flap, as of air suddenly blown into a wet bladder, is heard. At times, during the act of swallowing with closed nostrils, the air does not enter the tympanum, and a forcible expiration with closed nostrils is requisite to ensure its admission; but when the air is forced in, a sound similar to the last described is produced, but of a louder and more defined cha-

racter. In certain cases there is an accumulation of mucus in the tympanic cavity, so that when air is forcibly injected a gurgling or bubbling sound is heard.

Treatment.—As before stated, the first step is to discover what has been done or is doing in violation of nature's laws, and to insist, as far as possible, on a proper mode of living. This having been attended to, remedial medical measures may be hopefully applied. These are, gentle counter-irritation over the mastoid processes by means of vesicating plaister or solution; and, where there is much congestion, with frequent attacks of pain, a leech or two may be applied beneath each ear; a stimulating gargle may be prescribed, and cold water freely used outside the throat. The tonsils, often much enlarged, may be washed with a solution of nitrate of silver (twenty grains to an ounce), and tonics administered. In very advanced cases, where the health is much deranged, the child anæmic, and its physical powers greatly depressed, it may be requisite at once to insist upon sea air, or at least change of air. The *prognosis*, in these cases is usually favourable; by careful management, the mucous membrane is gradually restored to a more natural state; the mucus disappears from the tympanic cavity, and the patient regains his hearing in a month or two. Cases of a less favourable character occasionally occur, where the ear-ache has been violent, the inflammation acute, and rigid bands of adhesion have formed in the tympanic cavity, or the membranes of the articulations of the ossicles have become rigid: these of course demand longer perseverance and greater attention, but are usually eventually cured.

(*d.*) CHRONIC CATARRHAL INFLAMMATION OF THE MUCOUS MEMBRANE LINING THE TYMPANIC CAVITY.

This affection differs from the last in the circumstance that mucus has collected in so large a quantity as to distend the tympanic cavity, and press upon the inner surface of the membrana tympani, so that this structure, becoming gradually atrophied and yielding to the pressure of the mucus within, has given way, and the discharge issues through the orifice thus made.

The *treatment* of this class of cases differs from that of the preceding in the use of the syringe and warm water twice, or

oftener, daily, to effect a complete removal of the secretion. The great desire of the friends to stop the discharge must be earnestly contended against, since that discharge is simply an effect and not a cause; and it is the latter which requires to be removed. Among the causes to which attention is frequently called, is the admission of cold air to the delicate mucous membrane of the tympanum through the external meatus. In these cases the artificial membrana tympani is to be used where the age of the child will permit it, and reference must be made to the chapter where it is described, together with its mode of application.

(*e.*) CHRONIC CATARRHAL INFLAMMATION OF THE TYMPANIC MUCOUS MEMBRANE AFFECTING THE BONE, DURA MATER, OR BRAIN.

The first effect upon the tympanic mucous membrane produced by scarlet fever and other predisposing diseases, is usually a simple catarrhal inflammation, *i. e.* the ciliated mucous membrane, which is naturally extremely thin, and pours out a very small quantity of thin mucus, becomes hypertrophied, and secretes copiously a viscid matter, which, being too abundant and thick to escape through the natural excretory passage—the Eustachian tube—gradually fills the tympanic cavity, and presses against the inner surface of the membrana tympani, causing the partial or entire destruction of that organ; the mucus then freely escapes into the meatus, and forms one of the class of cases usually comprised under the term *otorrhœa*, it being in reality a case of simple catarrh of the mucous membrane of the tympanum. So long as there is a free exit for the discharge, I believe that the disease rarely extends to the cerebrum; and fortunately in a large proportion of cases where the ear is injured by scarlet fever or other diseases, so large a section of the membrana tympani is removed, that the viscid mucus secreted has free egress from the tympanum. But, as stated, the membrana tympani sometimes remains entire, or has only a small aperture, or a part falls inwards and becomes attached to the promontory, thus making a septum, shutting off the tympanic cavity from the meatus. Sometimes membranous bands stretch across the tympanum, or scrofulous deposits accumulate. By one or other of the above circumstances, the secretion of the tympanic mucous membrane is prevented passing outwards; and it gra-

dually distends the tympanic cavity till it affects the osseous walls; and thus disease of the membranes of the brain, or of the brain itself, is originated.

Although, as just stated, simple chronic catarrh of the tympanic mucous membrane, when there is free egress for the discharge, rarely extends to the brain, the dura mater may nevertheless become diseased. In chronic catarrhal inflammation the tympanic mucous membrane becomes much hypertrophied and its vessels enlarged; and as these vessels are, through the medium of the bone, directly continuous with those of the dura mater, it is not surprising that the latter membrane should be affected, and we find it accordingly undergoing slight changes. One of these is hypertrophy; another is detachment from the petrous bone; and the third is atrophy and extremely firm adhesion to the bone. The bone is also liable to be slightly affected.

The following case illustrates the effects of simple catarrh of the tympanic mucous membrane, with free egress for the secretion.

Case I. *Catarrh of the tympanic mucous membrane; bone soft.*—A woman who had been deaf in both ears during many years, died of apoplexy, at the age of 64. On *dissection* of the right ear, nearly the whole of the membrana tympani was found to have been destroyed; the small portion which remains is thick and soft, and is in contact with the promontory. The malleus has disappeared, but the incus remains, and is attached to the stapes; the latter bone being wholly concealed by the thick mucous membrane. The upper osseous wall is soft.

Chronic catarrhal inflammation of the mucous membrane of the tympanum, *where the membrana tympani is entire*, and where there has been but slight catarrh from the mucous membrane, may also produce disease in the dura mater; but so far as my experience extends, no cases have occurred in which the disease has advanced to the injury of the brain, so long as there is not more discharge than can pass away through the Eustachian tube. Cases of this class have come before me when making dissections of the ears of patients who have died of other diseases; and the following brief notices indicate the state of incipient disease that may be present; and further consideration will show that it is likely to assume a very serious character,

when, under the influence of exciting causes, the quantity of the secretion is much increased.

Dissection. Mucous membrane of the tympanum thick; membrana tympani entire; bone carious; dura mater ulcerated; the arachnoid in contact with the tympanic mucous membrane.—A man who had been many years deaf, died of consumption at the age of 50. *Right ear.*—The membrana tympani is white, concave, and very thick, and the whole of its inner surface adheres to the inner wall of the tympanum, while the ossicula are firmly bound together by bands. The membrane lining the mastoid cells is thick, and the cells contain a viscid fluid. *Left ear.*—In much the same state as the right, but there was a carious orifice in the upper wall of the tympanum. The dura mater was thin in some parts, and ulcerated in others, so that the outer surface of the visceral arachnoid was in contact with the mucous membrane of the tympanum.

Dissection. Mucous membrane of the tympanum thick; membrana tympani entire; bone carious; dura mater atrophied, ulcerated.—A woman, aged 65, died of paralysis. Many years previous to her death, deafness slowly came on in the right ear, after repeated attacks of ear-ache. *Dissection of right ear.*—Membrana tympani white and thick, and a large membranous band connects the incus with the inner wall of the tympanum, so as nearly to conceal the stapes. The tympanic mucous membrane is four or five times its natural thickness, and adheres firmly to the bone. The upper osseous wall of the tympanum is cribriform, so that at various points the thickened mucous membrane is in contact with the outer surface of the dura mater. The dura mater is very thin, and presents two or three small orifices.

In another woman, aged 70, who died of apoplexy, and who had been many years deaf, the following was the condition of the *left ear*. The membrana tympani was thick and opaque, more especially at its posterior part; and its inner surface firmly adhered to the inner wall of the tympanum and to the stapes, which bone is concealed by bands of adhesion. The upper osseous wall of the tympanum is carious, and presents several large orifices, which allow the dura mater to be in contact with the thickened mucous membrane.

Treatment.—Chronic catarrhal inflammation of the mucous membrane lining the tympanum is usually attended by so

extensive a destruction of the membrana tympani, that fortunately the discharge finds a free outlet, however viscid it may be. The effects, therefore, are confined to a certain amount of congestion of the dura mater covering the petrous bone. In cases of this simple kind, it is therefore not uncommon to meet with symptoms of slight cerebral irritation, which gradually yield to treatment by local depletion and gentle counter-irritation. The majority of these cases result from an attack of scarlet fever. The following is an instance :—

Case II. *Catarrh from the tympanic mucous membrane after scarlet fever; destruction of each membrana tympani; attacks of giddiness.*—Miss A. H., aged 15, consulted me in November, 1845, on account of a discharge from each ear, accompanied by dulness of hearing and frequent giddiness. She stated that seven years previously she had an attack of scarlet fever, for which she was confined to her bed. During the fever a copious discharge issued from each ear, and the hearing was greatly diminished. For the last three years there has been so much less discharge, that it has not reached the orifice of the ear for two or three weeks at a time; but with this diminution of the discharge the deafness has been aggravated. She now complains of frequent attacks of giddiness.

Upon *examination,* each membrana tympani was discovered to be entirely absent, and the mucous membrane, which was thick and red, was the source of the secretion. Watch heard at one inch from the right ear, and at two inches from the left. The *treatment* consisted in the application of leeches below the ears; the use of a very weak solution of the diacetate of lead as an injection after tepid water; and the administration of the twentieth of a grain of the bichloride of mercury twice daily. Under this treatment the congestion of the mucous membrane of the tympanum greatly diminished, the discharge gradually decreased in quantity, and the giddiness disappeared.

Other cases might be cited in which catarrhal inflammation of the tympanic mucous membrane had been accompanied by symptoms of giddiness; some resulted, as in the last case, from scarlet fever; others from measles. The treatment in each case was very similar; and although in some instances the pain extended over a great part of the head, and was even accompanied at times by vomiting, all ultimately recovered.

In the case above cited the entire membrana tympani was absent, so that the whole of the discharge could be removed by syringing. In those which follow, part only of the membrana tympani was destroyed, and the remainder prevented the egress of the matter; additional care had therefore to be exercised to ensure the complete removal of the discharge.

Case III. *Catarrh from the mucous membrane of the left tympanum; perforation of the membrana tympani; pain in the left side of the head.*—F. H., an architect, aged 44, consulted me in 1852, respecting a discharge from the left ear, accompanied by pain and tenderness over the left side of the head. He stated that since childhood he had been subject to a discharge from the left ear, which had never ceased for more than a few days. During the last five or six years he has also complained of pain in the left side of the head, extending in front as far as the temple, and behind over the region of the mastoid process. Slight excitement or fatigue produces considerable aggravation of the symptoms. At times, the pain in the ear comes on suddenly, and is followed by very abundant secretion. About a month ago, during a cold, he had an attack of pain in the ear, attended by a loud whizzing sound and great additional tenderness over the left side of the head. On *examination*, an ulcerated orifice, about two lines in diameter, was observed in the posterior part of the left membrana tympani, through which oozed a large quantity of thick tenacious discharge, having an offensive odour. On removing this, the mucous membrane of the tympanum was seen to be red and much thicker than natural, so as to project towards the orifice in the membrana tympani, and in some degree prevent the free passage of the secretion through the orifice. The *treatment* in this case consisted in keeping up a discharge from the mastoid process, and in administering small doses of the bichloride of mercury in conjunction with sarsaparilla. The ear was also syringed twice daily with warm water, care being taken that the stream was directed to the orifice in the membrana tympani, so that the water might be made to enter the tympanic cavity, and, by mixing with the mucous secretion, so soften it as to facilitate its discharge through the orifice of the membrane. This treatment was very successful, for the pain around the ear diminished greatly by degrees, and the attacks of pain within the ear

became less frequent. The quantity of the discharge, however, remained much the same until a weak solution of the diacetate of lead was injected. This treatment was pursued for four months, at the end of which time the patient no longer complained of any pain in the ear or head, and the quantity of discharge had greatly decreased.

Cases similar to the above being frequently met with in practice, the following brief particulars of a very similar instance are subjoined.

Case IV. *Catarrhal inflammation of the tympanic mucous membrane; perforation of the membrana tympani; pain in the head, and giddiness; irritation of the portio dura nerve*—Miss M. S., aged 30, says, that since childhood, with exception of an interval of two years' duration, she has had a discharge from the right ear, following an eruption on the head. For eight or nine years has complained of pain at the top of the head, with heat and a sense of weight. This pain sometimes suddenly shoots across the head from the right ear. She suffers at times from giddiness, and for the last few months has had a feeling of confusion in the head; six months ago had twitchings of the muscles on the right side of the face. On *examination*, the membrana tympani of the right ear was seen to be perforated at its upper and anterior part, the aperture measuring about a line and a half in diameter. Mucus oozed through the aperture, and having been removed, the mucous membrane of the tympanum was observed to be thick and red. The *treatment* was the same as in the last case, except that leeches were applied below the ears once a week. After three months all the symptoms were much diminished, and the patient was ordered to continue the counter-irritation and the injection with warm water.

From the situation of the orifice in the membrana tympani in the above case, it will be observed that in the usual position of the head during the day, a portion of the mucus must have been confined to that part of the tympanic cavity which was beneath the orifice; there was, however, a free escape of the mucus during the recumbent position, as there was then an opportunity for the complete evacuation of the contents of the tympanic cavity; and as the symptoms were not very urgent, it appeared advisable to try the effect of counter-irritation, instead of enlarging the orifice in the membrana tympani.

In treating the class of cases now under consideration, it is of great importance to be able to decide when the membrana tympani should be perforated by artificial means, or when an orifice in it should be enlarged. To the perforation of the membrana tympani, much objection exists on account of the difficulty of keeping the aperture open. It is seldom that a punctured aperture, even of large size, does not close in the course of two or three days. I have found, even after making a triangular flap and turning it down, that the orifice thus produced sometimes closed in a few days by the effusion of fibrine. It is, however, not always possible to make a triangular aperture of this kind, either on account of the small calibre of the meatus, or the extreme sensibility of the surface of the membrana tympani. The only sure way of keeping open an aperture in this membrana with which I am acquainted, consists in applying to it the point of a fine stick of potassa cum calce. Such a proceeding appears, at first sight, to be attended with danger to the adjacent parts; but, in reality, the action of this substance is wholly under control; for the injection of warm water at once entirely stops its escharotic properties. During and after the application of this remedy, to which I have resorted in the destruction of polyhoid growths, I have never known any inflammation to arise. At the same time there is no doubt, that in cases such as we are now considering, when there are symptoms of cerebral irritation, extreme caution should be used, and every other possible measure adopted before having recourse to this, or indeed any other operative proceeding; and as remedial measures of a different kind are generally sufficient to alleviate or cure the disease, the operation of perforating the membrane is rarely required. The potassa cum calce has been used by me in only one case.

In those cases of catarrhal inflammation where the quantity of discharge from the tympanic mucous membrane has not been sufficient to cause ulceration of the membrana tympani, but where the superabundant quantity has passed away through the Eustachian tube, it seems to me that, as a general rule, unless the disease has made great progress and threatens the life of the patient, the ordinary remedial measures already adverted to, will be found sufficient to arrest its progress and produce considerable improvement. The following cases will illustrate this

branch of the subject, and it will be seen that they differ from those last quoted in the circumstance of the membrana tympani being still entire.

Case V. *Chronic inflammation of the mucous membrane of the tympanum, without perforation of the membrana tympani; giddiness, &c.*—M. C., aged 27, consulted me on the 15th of February, 1857. She said that for four months she has had at times a sensation of pricking in the right ear, accompanied by a humming noise, deafness, giddiness, a sensation of swimming in the head, and pain over the right side. During the last few days has complained of a throbbing in the ear, attended with great pain, and followed by discharge: has also been "light-headed" at night. Every time she draws in breath through the nose, she states there is a rattling sound in the ear, and for a minute or two she hears better. The hearing is also better after a copious discharge. On *inspection*, the surface of the meatus was found to be red, denuded of epidermis, and secreting a muco-purulent fluid. The membrana tympani was opaque, especially at its lower part; the Eustachian tube pervious, and the power of hearing much diminished. Considering the case to be one of chronic inflammation of the mucous membrane of the tympanum, with a collection of mucus in the lower part of the tympanic cavity, and that the irritation of the meatus was only a symptom of this inflammation, the treatment adopted consisted in the application of leeches below the ear, and of blisters behind it; under this treatment the head symptoms greatly diminished, while the hearing was much improved. On the 12th of May, the patient was again seized with violent pain in the right ear, extending across the head and towards the forehead. On the 17th she became much worse, and was insensible for some hours. Blisters were applied to the nape of the neck, and a constant discharge was kept up through them for some weeks; small doses of calomel were also administered until the gums became tender. The acute symptoms were soon abated, but counter-irritation was kept up for a long period, and iodide of potassium and sarsaparilla were afterwards administered. Treated in this way the symptoms of cerebral irritation wholly subsided, and the power of hearing greatly improved.

Although it is difficult to determine positively whether there is a collection of mucus in the tympanic cavity, the history and

symptoms of the case, and the peculiar sodden condition of the membrana tympani, such as was presented in this case, especially at the lower part, left little doubt in my mind that mucus had collected; and the second attack was probably the result of a collection of this fluid, causing irritation and pressure on the labyrinth. It is possible that more speedy relief might have been effected, by allowing an escape of the mucus through an orifice in the membrana tympani; but I was quite aware, from previous operations, of the great difficulty of keeping open the aperture, even if the means employed did not cause a serious increase of the inflammation. The important rule to bear in mind, is to keep up counter-irritation long enough to cause absorption of the fluid, and the arrest of the inflammatory action which produces the secretion.

As stated, there is some difficulty in ascertaining positively whether there is a collection of mucus in the tympanic cavity. Sometimes the opacity and sodden appearance of the membrana tympani is the chief indication; but often the gurgling sound, produced by the entrance of air into the tympanum, or the peculiar flap, resulting from the air striking against a soft flaccid membrane, shows, at least, that there is a considerable quantity of mucus in the cavity. The following case will further elucidate the subject:—

Case VI. *Chronic catarrh of the mucous membrane of the tympanum; giddiness, and symptoms of cerebral irritation.*—E. Middleton, aged 14, was admitted under my care, at the St. George's and St. James's Dispensary, in December, 1849. She had an attack of measles at four years of age; since which she has complained of much pain in both ears and in the front of the head, attended by throbbing and frequent attacks of giddiness, especially when walking quickly. At times, also, she has been delirious and very violent. The head symptoms have much increased in severity since the cessation of the discharge, which took place nine months previous to her consulting me.

On *examination*, the membrana tympani of the right ear was seen to be very white, and parts of it had fallen in. Hearing distance, with watch, half an inch. *Left ear.*—The membrana tympani is milky white: hearing distance same as right ear. Air passes into each tympanum during an expiration with closed nostrils, producing a gurgling sound. The *treatment*

consisted in the use of a blistering ointment to the nape of the neck, by which a constant discharge was kept up for more than a month, and in giving tonic medicines. By slow degrees the head symptoms abated; she was free from giddiness for days, and the occasional attacks were in a mitigated form, and for short intervals only. At the end of two months, she had so far improved as to be able to enter service as a housemaid.

Although the general cause of this kind of inflammation is most usually an attack of scarlet fever, measles, or common cold, this affection may follow a blow on the ear or head; and it is probable that in the following case a blow was the primary cause of the disease.

J. S., aged 35, was admitted under my care, in the Hospital, on May 1st, 1853, complaining of pain in the right ear and down the back, accompanied by faintness when the nose was blown, or the ear was pressed. She stated that when she was ten years old, she received a blow on the right ear, since which that ear has been deaf. Two years ago, discharge took place from the right ear, and has continued. On *examination*, the membrana tympani was observed to have fallen in, and there was a valvular opening at the lower part, through which discharge was forced upon blowing the nose. Regarding the case as one of long standing disease of the tympanic mucous membrane, causing irritation of the brain, I at once ordered a seton to be placed in the back of the neck, the effect of which was slowly, but entirely, to remove pain from the ears, the head, and the spine.

The general opinion respecting the mode in which disease progresses from the ear to the brain, appears to be that the bone becomes carious, the dura mater ulcerates, the arachnoid and the pia mater, and ultimately the substance of the brain, participate in the disease, as the result of direct extension from the ear. A careful examination of the *post-mortem* appearances found in some of the fatal cases shows that the disease does not always advance from the ear to the brain as the result of continuity; indeed, in some instances an abscess is developed in the brain without ulceration of the mucous membrane of the tympanum, or caries of the bone. It would appear that constant irritation in the tympanic cavity, produced by chronic inflammation of the mucous membrane, with the absence of a free outlet

for the matter, is sufficient to produce an abscess in the substance of the cerebrum. Dr. Abercrombie states: There is reason to believe that extensive suppuration within the cavity of the tympanum is capable of producing symptoms of great urgency, especially if there should be any difficulty of finding "an outlet;" but the evidence derived from dissection shows that these symptoms of great urgency are associated with disease of the cerebral substance, without the existence of caries of the petrous bone. Thus in a case published by Dr. Joseph Williams,* of which the following is an abstract, there was no caries of the petrous bone.

Case VII. *Ulceration of the tympanic mucous membrane; abscess in the substance of the brain; petrous bone not carious.*— E. B., aged 23, not strong, but her health, till about a fortnight before her death, had been uniformly good: she was then suddenly seized with violent headache, and most severe pain in the right ear; chilliness next came on, which in a short time amounted to actual rigors. The pain in the ear now increased, and for several hours there was an oozing of blood from the meatus. The next day the discharge became thin and ichorous; the febrile symptoms rapidly increased; she fell into a state of semi-stupor, and the discharge became thick, fetid, and purulent. She died on the third day after the appearance of the acute symptoms.

Autopsy.—The dura mater was softened, and easily broken down over the petrous bone. In the substance of the middle cerebral lobe was an abscess containing an ounce of pus, which had a fetid odour, was of a dark yellow appearance, and was mixed with serum. The abscess itself appeared to be about the size of a five-shilling piece. It had penetrated deeply into the substance of the brain, and its contents were mixed with blood. The portion of the brain surrounding the abscess was soft and very vascular. The surface of the petrous bone was of a somewhat dark colour, and on sawing into it, the inner portion of the petrous bone was found increased in vascularity, and even in some parts ulcerated; the secretion was fetid and puriform, and the mucous membrane completely destroyed. The membrana tympani was ulcerated nearly through, and some of the bones of the external ear were destroyed. Dr. Williams adds:

* Treatise on the Ear. London, 1840.

"Dr. Alison has communicated to me a case where abscess was found in the brain, consequent upon disease attended with discharge. The petrous bone was sound, consequently there was no communication between the matter of the ear and that of the brain."

In other cases, a considerable portion of healthy brain is found to exist between the abscess and the petrous bone. For the particulars of the following case, and for the opportunity of making the dissection, I am indebted to Dr. Merriman.

Case VIII. *Catarrh of the mucous membrane of the tympanum, since measles; attack of arachnitis; death; petrous bone not carious; abscess in the substance of the brain; adjacent cerebral matter healthy.*—M. K., a widow, aged 26, of a scrofulous diathesis, and much confined to the house as a maker of military caps, came under the care of Dr. Merriman, at the Westminster General Dispensary, for a cough, on the 7th January, 1846. On the 26th, she complained of ear-ache on the right side, and then said that she had been subject to a discharge from the right ear since an attack of measles when a child: the discharge was at times very offensive. Previous to the present attack, no pain had ever been felt; but she is said, for twelve or sixteen months to have suffered much from head-aches, being at times forgetful and very giddy. She has also fallen away very much. At first, only fomentations were ordered, which were followed by leeches; but without any benefit. The pain greatly increased, and was described as if, at times, a knife were being thrust into the ear; and then, as if there was a sawing outside the ear at its edge. During paroxysms of pain the patient screamed out suddenly, and then could not open her mouth. On two occasions a small quantity of discharge was observed, but its appearance afforded no relief. When the pain at all relaxed she lay in a partial sleep. On the 17th of February she became insensible, but put out her tongue when loudly told to do so, and then relapsed into a comatose state. She died on the evening of the 17th, twenty-three days after the attack of pain had commenced.

Autopsy.—When the skull was sawn through, pus flowed from within the dura mater; and upon examination it was found to come from an abscess which occupied the whole of the upper part of the right cerebral hemisphere. The substance of the

surrounding brain was healthy. The dura mater above the part cut off by the saw presented a patch of coagulable lymph, about the size of a fourpenny piece; lymph was also effused on the surface of the dura mater, covering the petrous bone, and a portion of it was detached from the bone. Upon dissection of the ear, the membrana tympani was absent; the tympanic mucous membrane, and that of the mastoid cells, was thick and soft, and covered by a large quantity of caseous, scrofulous matter. The upper tympanic wall was of a dark colour, extremely thin, and perforated by numerous blood-vessels. The dura mater covering the upper part of the petrous bone, and that lining the squamous bone, was very thick and detached from the bone, and a large quantity of purulent matter was deposited between the dura mater and the arachnoid. The arachnoid membrane was highly congested. In some parts the purulent matter had passed through the dura mater, and was in contact with the bone. The outer surface of the dura mater, forming the lateral sinus, is rough where in contact with the inflamed bone; and the internal surface of the sinus had portions of fibrin adhering to it.

The presence of a portion of healthy brain between the abscess and the petrous bone, has induced some observers to conclude that abscess in the cerebrum is the primary disease, and affection of the ear the result. The objections to this opinion are: Firstly, that the cases of abscess in the cerebrum are usually preceded by a long standing affection of the ear. Secondly, that the portion of bone which becomes carious is far from being the most dependent part of the cerebral fossa. And, thirdly, that although the abscess may be very large, the walls of the tympanum only are the real seat of disease in the bone.

The very insidious progress of the disease in its course towards the brain has been already adverted to. In some cases no symptom indicates to the patient that the brain has become affected until the sudden appearance of the acute stage; the presence of a discharge from the ear and a certain amount of deafness are, as they assure the medical man, the only unpleasant symptoms. Nevertheless, it does seem to me that, by a careful professional examination of the patient, the early stages of the disease might be detected; for in cases where my suspicions have been aroused by the condition of the ear and

the inward progress of the disease, I have not unfrequently found an unnatural sensibility of the brain upon percussing the suspected side of the head. In some cases the discharge may take place for a month or two, and then disappear for a similar period; where this cessation occurs, however, there is usually tenderness in or about the ear. The simple fact of discharge occasionally issuing from the ear should induce the medical man to make a careful investigation.

The exciting causes of the acute cerebral symptoms are various: a blow upon the head, violent exercise, a cold, stimulating applications, or any depressing influence, may bring them on. Sometimes no exciting cause can be detected beyond the progress of the chronic affection of the ear.

One of the first symptoms of the disease assuming an acute form is the cessation of the discharge; this is the result of inflammatory action, and it is so commonly associated with the origin of acute symptoms, that the stoppage of the discharge has been considered as the cause instead of the effect of acute inflammation; and medical men have been afraid to stop a discharge from the ear, lest inflammation of the brain should be induced. If this fear were confined to the exclusion of all irritating astringents in these cases, it would be salutary; but when it gives rise to a belief that it is injudicious to interfere in any way with a disease of the ear which is slowly progressing, and which, if neglected, will probably terminate in the death of the patient, it may act very prejudicially. Mr. Wilde, in his work on "Aural Surgery," before alluded to, has some interesting observations on this subject.

Two cases of abscess in the substance of the cerebrum, arising from catarrhal inflammation of the mucous membrane of the tympanum, have been already described. In that which follows, the *post-mortem* examination was attended by me with the late Mr. Farish. Death took place from arachnitis, and an abscess was found in the middle cerebral lobe; but the cause of the irritation appeared to be the presence of scrofulous matter in the tympanum.

Case IX. *Scrofulous matter in the tympanic cavity; caries of the upper wall of the tympanum; arachnitis; abscess in the middle cerebral lobe.*—Miss H. G., aged 9½, fair and delicate, but not unhealthy, had measles when quite a child, though not

severely; since the measles has had an offensive discharge from the left ear, attended by occasional attacks of pain. On the 5th May, 1845, she was seized with symptoms of active fever. She did not complain of head-ache, but, when questioned, said there was some uneasiness about the vertex. The discharge had ceased. There was constant vomiting. Calomel and opening medicines were administered, followed by effervescent salines. On the 7th she seemed well; every unpleasant symptom had vanished; her pulse was natural, her tongue clean, food was relished, and there was no pain. On the 8th the bad symptoms re-appeared. On the 10th she complained of pain in the left ear, which, by degrees, became excruciating to the last degree; she, however, retained her faculties till from twelve to twenty hours previous to her death. The only symptoms of derangement of the nervous system were, some vomiting and a slight degree of paralysis of the muscles on the left side of the face. The remedial means employed were leeches, calomel, James's powder, and a little opium; and these were employed freely from the 11th. In spite of all efforts, she gradually became comatose; but even then frequently shrieked out from pain on the left side of the head. She died at midnight, on the 15th, twelve days after the occurrence of the first symptoms.

Autopsy.—Upon removing the calvaria, the dura mater was observed to be red, and its blood-vessels distended. The cavity of the arachnoid on the left side contained nearly half an ounce of yellow purulent matter; lymph was deposited upon the inferior surface of the posterior lobe of the left hemisphere. The arachnoid and pia mater covering the inferior surface of the middle lobe on the left side, were thick and dark coloured over a superficies about the size of a sixpence. This thickened portion corresponded with an orifice in the dura mater covering the upper surface of the petrous bone. In the interior of the left middle cerebral lobe, there was an abscess as large as a small hen's egg, in which a quantity of dark coloured fetid matter, of a watery consistence, was contained. There was no communication between the abscess and the cavity of the arachnoid. The dura mater covering the upper surface of the petrous bone was three or four times its usual thickness, and its inner surface darker coloured than natural and rough; being in some parts firmly adherent to the bone, and in others detached

from it. About the centre of the upper surface of the petrous bone, the dura mater presented an orifice about a line in diameter, directly beneath which was another and smaller one in the petrous bone, measuring about a quarter of a line in diameter. The latter orifice, and several smaller ones about the size of pin holes, were filled by concrete scrofulous matter, which projected from the tympanic cavity. The superior wall of the cerebellar corner of the tympanum presented two carious orifices. The tympanic cavity and mastoid cells were completely full of scrofulous matter, having the consistence of soft cheese, by which the mastoid cells appeared to be much dilated; the mucous membrane of the tympanum was but slightly thicker than natural, and, where orifices existed, they appeared to have been produced by atrophy, resulting from the pressure of the scrofulous matter rather than from the process of ulceration. The greater part of the substance of the membrana tympani had been destroyed, and the remaining fibres were adherent to the inner wall of the tympanum.

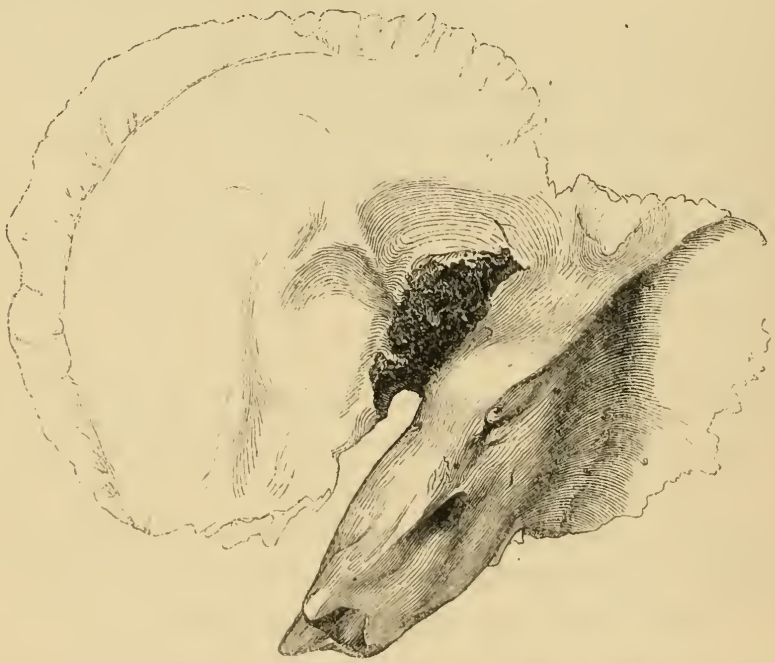
(*f.*) ULCERATION OF THE MUCOUS MEMBRANE OF THE TYMPANUM.

This disease is rarely met with, and its treatment is the same as that of chronic catarrhal inflammation.

The following case, belonging to this class, was supplied to me by Mr. Obré, together with the preparation.

Case I. *Scrofulous ulceration of the tympanic mucous membrane; destruction of the upper wall of tympanum; purulent degeneration of the middle cerebral lobe.*—A young lady, aged 18, of scrofulous diathesis, and who was treated by a medical friend, was attacked, on November 20th, 1846, with fever and hysterical symptoms, unaccompanied by any pain. The following day symptoms of pleuritis appeared, accompanied by severe pain in the right side of the head. It was now ascertained that she had been deaf in the right ear for two years, and that the deafness was preceded by a fetid discharge. Notwithstanding the most active treatment, the symptoms of cerebral irritation grew worse daily, and death occurred on the ninth day of the attack. The patient's memory and intellect were perfect up to the hour of her death, which was preceded by epileptic fits. There was a very fetid odour about the ear, but no discharge. On dissection, the periosteum was found detached from the

exterior, and the dura mater from the interior, of the squamous bone, and separated by dark coloured pus. The dura mater on the right side of the head was gangrenous over a large surface; and the middle lobe of the right hemisphere was in a state of suppuration, being principally composed of pus. On careful inspection of the petrous bone, the whole of the upper wall of the tympanum was found to have been destroyed by caries; and the tympanic cavity communicated with that of the cerebrum by an aperture, measuring three quarters of an inch in length, and a third of an inch in breadth.



THE INTERNAL SURFACE OF THE TEMPORAL BONE, SHOWING THE TYMPANIC CAVITY IN A STATE OF DISEASE; THE ENTIRE UPPER OSSEOUS WALL OF THE TYMPANUM HAVING BEEN DESTROYED BY CARIES.

It thus appears that in some cases the disease of the ear, instead of an abscess, produces *purulent degeneration* of the substance of the brain.

Case II. *Ulceration of the mucous membrane of the tympanum; caries of the bone; partial destruction of the portio dura nerve, and softening of the dura mater.*—John Cochrane, a labourer, aged 44, was admitted under the care of Dr. Kingston, at the Westminster Hospital, for consumption, in October, 1849. His history is, that twenty-four years previously, discharge took place from the right ear, and has continued ever since. He has long been deaf in that ear, but has not complained of any head symptoms. On examining the ear the membrana tympani was

absent, and the tympanic mucous membrane was covered by an opaque discharge like cream. When that was removed, the mucous membrane was seen to be thick and its surface rugose. The patient died of consumption about a month after his admission into the hospital. Some days previous to his death, there was a paralytic condition of the muscles of the right side of the face; but there was a partial recovery of their action a short time previous to death. On dissection, the mucous membrane lining the tympanic cavity was found very thick and dark coloured, excepting at the anterior part, where it had been destroyed by ulceration. The stapes was absent. At the upper part of the tympanum the bone was carious; the aqueduct of Fallopius was exposed for a space of more than a line and a quarter in length, and the portio dura nerve, in a soft and ulcerated state, protruded from it. The part of the nerve towards the tympanum was gelatiniform in its consistence, and extended downwards so as to cover the fenestra ovalis. The posterior half of the nerve was healthy. The dura mater covering the petrous bone was thicker than natural; and a small circular portion, about a line and a quarter in diameter, was of a dark brown colour, and of a pulpy consistence. It was slightly raised above the surface of the surrounding membrane, and on being touched broke up, and exposed a carious orifice in the bone below it. The bone around the orifice was very thin. The brain was not diseased.

In this case there appeared no obstacle to the free escape of the discharge, excepting its tenacity and its concretion in the tympanic cavity; and it is worthy of observation in a practical point of view, that unless the syringe with warm water be frequently used, the matter secreted by the mucous membrane of the tympanum is apt to accumulate and solidify, and so cause a certain degree of irritation in the adjacent parts.

In the following, which is the last case I shall cite in reference to this class of diseases of the tympanum, the disease was evidently of a scrofulous character. The mucous membrane of the tympanum had ulcerated, and its place was occupied by scrofulous matter. The substance of the brain had also undergone scrofulous degeneration.

Case III. *Ulceration of the mucous membrane of the left tympanum; softening and tubercular deposit in the corresponding*

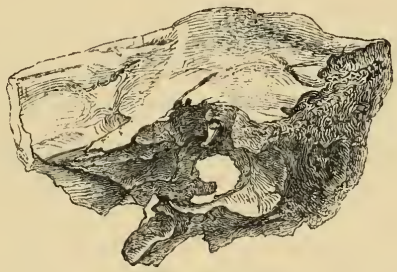
cerebral lobe.—Wm. K., aged 4, was admitted under my care, at the St. George's and St. James's Dispensary, in March, 1849. He was described as never having had good health, his bowels having always been irregular, and his abdomen tumid. In earliest infancy discharge of offensive matter took place from the left ear, and has never disappeared for more than a few days at a time. The ear appeared tender to the touch, although no pain had been complained of. Has suffered from pain in the forehead and eyes for some months.

Three days before my seeing him, he fell down at school in what appeared to be a fit, and remained insensible for some minutes. Upon his recovery he was found to have lost the use of the muscles on the right side of the face and body. When seen by me he was in a state of extreme exhaustion, speechless and hemiplegic. On the following day he complained of great pain in the left ear and the left side of the head, and there was an abundant, creamy, offensive discharge from the ear.

On *examination*, the whole of the membrana tympani was found to have been destroyed, the tympanic mucous membrane had disappeared, and the cavity contained thick, caseous, scrofulous matter. The pain in the head and the convulsive fits increased in intensity; he often remained insensible for hours together; his strength gradually declined; and, in spite of the most active treatment with leeches and mercury, he died on the 21st of May.

Autopsy, sixteen hours after death.—The dura mater covering the upper surface of the cerebral hemispheres was healthy; but in the substance of the left cerebral hemisphere, above the middle cerebral lobe, was a space measuring three inches from behind forwards, an inch and a half from without inwards, and an inch from above downwards, which was much harder than natural, and studded with tubercles; and between this mass and the lateral ventricle the brain was pulpy. In the left lateral ventricles was a small quantity of turbid serum. The dura mater covering the upper surface of the petrous bone was more vascular than natural, and on its free surface was a patch of blood. The upper wall of the tympanum was dark coloured, and the thick mucous membrane was seen beneath it. The tympanic mucous membrane was very thick, and of a dark purple colour, its vessels being distended. The upper part of

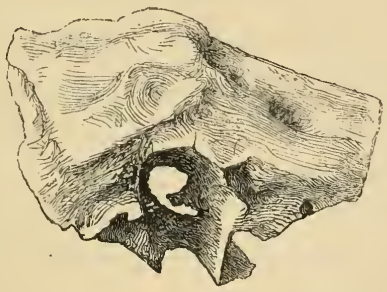
the tympanum was so filled by this thick membrane, that the scrofulous matter and pus were retained by it. The scrofulous matter itself was composed of fine granules, of epithelial cells, and of very fine crystals, which latter were stated by Dr. Garrod to consist of phosphate of ammonia and magnesia. The stapes was disarticulated from the incus, and the ossicles were concealed by the thick mucous membrane. The lower osseous wall also was thin and of a red colour, and presented an orifice



THE LOWER OSSEOUS WALL OF THE TYMPANUM INCOMPLETE, SO AS TO ALLOW OF A COMMUNICATION BETWEEN THE TYMPANIC CAVITY AND THE FOSSA JUGULARIS.

which allowed of a communication between the tympanum and the fossa jugularis.

This case is especially interesting, from the fact that the disease had extended downwards to the lower osseous wall, as well as upwards. This lower wall of the tympanum is frequently formed by a thin layer of bone, which separates it from the fossa jugularis. In many instances this osseous lamina is



THE ORIFICE SEEN FROM THE JUGULAR FOSSA.

deficient in parts, and the outer surface of the mucous membrane of the tympanum is in contact with the jugular vein. Disease may thus be propagated from the tympanic cavity to the jugular vein.

CHAPTER XIII.

THE CAVITY OF THE TYMPANUM (*concluded*).

a. RIGIDITY OF THE MUCOUS MEMBRANE — CAUSE OF DEAFNESS IN ADVANCING YEARS—TREATMENT—CASES. *b*. THE FORMATION OF BANDS OF ADHESION. *c*. ANCHYLOSIS OF THE STAPES TO THE FENESTRA OVALIS—PATHOLOGICAL OBSERVATIONS—TREATMENT—CASES. *d*. DISCONNEXION OF THE INCUS AND STAPES — PHYSIOLOGICAL OBSERVATIONS—PATHOLOGICAL OBSERVATIONS—CASES.

THE mucous membrane of the tympanum may be subject to chronic inflammation, complicated or not with rheumatism, at any period of life, and, if neglected, this is liable to terminate in a rigid state of the membrane; so that the ossicles become bound together more firmly than is natural. In advanced years, this rigid condition seems to take place without any symptom of inflammation. The membrana tympani also partakes of this rigid condition, and, what is of far greater importance, the base of the stapes may become much more firmly fixed to the border of the fenestra ovalis than is natural. As a consequence, the membrane of the fenestra rotunda and the fluid of the labyrinth participate in this fixed condition. This affection is less prevalent in the young than in the adult, in whom it is liable to occur after repeated attacks of cold, whether with pain or not. It is, however, most frequent in persons advancing in life, and may, in fact, be considered as *the* disease which causes *deafness in advancing years*. The generally received opinion that in this kind of deafness the nervous system is at fault, is manifestly incorrect, as proved by the symptoms, and by the mode of relief found beneficial.

The *diagnosis* of this affection is far from being difficult; although, as will be seen, it offers very little to guide the medical man, except the history of the case. Thus, there is very often little or no opacity, or even dulness, of the membrana tympani; the Eustachian tube too is pervious, and the air enters naturally.

Not unfrequently, however, the membrana tympani shows signs of chronic inflammation, in hypertrophy and a greater concavity than natural; while the air, when forced into the tympanum, enters it with a dull flapping sound instead of the normal crackling. Sometimes on forcing the air into the cavity very suddenly, a greatly louder crackling than is natural is heard; and the patient occasionally hears better for a short time subsequent to the operation. A symptom of considerable importance in forming a diagnosis, is the peculiar character of the deafness. Many patients will most distinctly hear a single voice, although low, but are puzzled to hear anything distinctly when two or more persons are speaking; others hear the voice, but cannot discriminate the words; others again can hear slow conversation, but cannot follow it when rapid. These symptoms indicate that the *adapting power* of the ear, dependent, as already shown, upon the ossicles and their muscles, is at fault. But the history of the case, showing it to be one of slow hardening of the tympanic mucous membrane, together with the absence of all those symptoms which render it liable to be confounded with other diseases, as nervous deafness, obstruction of the Eustachian tube, &c., are usually sufficient to enable an attentive observer to form a correct diagnosis.

Treatment.—It is highly important to inquire whether any remedial measures can be suggested which will tend to diminish a rigid state of the mucous membrane, and consequently improve the power of hearing. Practical experience induces me to believe that not only may the thick membrana tympani be relieved, but the thickened mucous membrane be so reduced as to offer but little impediment to the function of hearing.

The most suitable application for this purpose which has been tried by me, is that of a solution of nitrate of silver, of a strength varying from half a drachm to a drachm of the salt to an ounce of distilled water. Proceeding from the exterior orifice of the meatus externus, the passage may be touched to an extent varying from one-half to two-thirds of its length every third or fourth day. In some cases the membrana tympani also may be washed with a solution of this salt of six grains to the ounce. When the noises are loud, and the symptoms indicate much congestion in the ear, leeches should be applied immediately *below*, not *behind* the ears; and where there is irritation of the

external tube, an ointment, composed of half a drachm of pulvis cantharidis added to an ounce of simple ointment, and applied behind the ear, either daily or every other day, will be found beneficial.

The administration of alterative doses of pilula hydrargyri, hydrargyrum cum cretâ, or the hydrargyri bichloridum, is very useful; but it should always be recollected that these doses ought to be so proportioned as not to produce debility or any other unpleasant symptom; in other words, so gentle should be the alterative that no sensation should suggest to the patients that they are under a course of medicine.

In addition to the medicines described, patients should be cautioned to avoid warm rooms and sitting very near the fire; daily exercise, and, where possible, on foot, should be taken in the open air, together with a warm bath every week or ten days. This course of treatment has been productive of the greatest advantage in several cases of deafness of a most unpromising character. Some of the cases about to be cited are those of patients who attributed their failure of hearing to old age.

The treatment pursued by continental surgeons in cases of rigidity of the tympanic mucous membrane, has been the injection of air by means of the Eustachian catheter. There can be no doubt that temporary benefit in these cases sometimes follows the use of the air douche, as well as the act of forcing the air into the tympanic cavity, by the patient holding the nose while he attempts a forcible expiration. But the very temporary character of this benefit, and its occurrence in only a few cases, does not induce me to recommend the performance of an operation; in fact, a forcible expiration by the patient usually answers equally well. On this subject I may quote the following judicious remarks from the article on the Diseases of the Ear, in the Cyclopædia of Surgery, by Mr. Wharton Jones,—an article characterised, as are all his works, by the most careful observation and patient research. He writes: "According to Kramer's 'Tabular View of the Frequency and Curability of Diseases of the Ear,' out of three hundred cases of diseases of the ear of all kinds, two hundred, in round numbers, required the air douche to assist the diagnosis, but about thirty only were improvable or curable by it. Of the remaining one hundred and seventy about thirty are put down

as cured, and about fifty as relieved, by the injection of vapours of acetic ether; this treatment having been continued for months. Of the remainder, eighty were considered incurable from the first, and not treated further than was necessary for exploration, I suppose; the rest remained rebellious to treatment. Dr. Kramer does not tell us how permanent his cases were. It will be seen from the above statement of the results of Itard's experience, and also from what I have related of my own, that the advantage gained is seldom permanent."

Case I. *Rigidity of the tympanic mucous membrane.*—The Rev. M. M., æt. 70, consulted me in 1855, on account of an increasing dulness of hearing, which caused him much inconvenience, as he could not hear general conversation. It had come on very gradually, without pain, noises, or any unpleasant sensation, beyond that of a feeling of heaviness in the ears. The deafness is increased by a cold, but not by fatigue. On *examination*, each membrana tympani was seen to be less translucent than natural; and though the Eustachian tube was natural, the air entered the tympanic cavity in a puff instead of producing a faint crepitation. The *treatment* consisted in keeping up a slight irritation by means of a vesicating plaister behind each ear, and in giving the bichloride of mercury in doses of one-thirtieth of a grain, using also a stimulating gargle. This treatment was continued, with intermission of the mercury, for a week at the end of each fortnight, for four months. At the expiration of that time, the hearing power was greatly improved, and the patient wrote to me as follows:—"I have not recovered the quick hearing of early life, which a man in his 70th year has no right to have; but I hear comfortably, and I am freed from that dunny sensation as if sounds came through a damp cloth."

Case II.—R. B., Esq., aged 80, in tolerable health, consulted me on 29th of March, 1844, on account of deafness in both ears. He stated, that three years before, the power of hearing began gradually to decline in the right ear, and had continued to do so up to the time of consulting me; that about six months previously the left ear had been similarly affected; and that his deafness had so much increased as to disable him from hearing the voice without the aid of a speaking-trumpet. He was unable to assign any cause for the deafness. On *examination*, the membrana tympani in each ear was observed to be dull and

opalescent; and although by aid of the otoscope the air was heard to pass into the tympanic cavities, yet it did so with the bubbling, crackling sound, indicating obstruction. Two grains of pilula hydrargyri were ordered to be taken every night, and a stimulating liniment to be applied around and below the ears. This plan having been persevered in for about three weeks, and some slight improvement experienced, the patient was directed to take one grain of hydrargyrum cum cretâ daily. At the end of two months this gentleman recovered his hearing, and gave up the use of the speaking-trumpet.

Case III. — J. P., Esq., aged 64, consulted me in July, 1845. During the last four or five years the right ear has been growing deaf, and the deafness has now so far advanced as to render the ear useless to him. Has been suffering from a cold for a few days, during which there has been a sensation of singing and of vibration in the head and ears, accompanied with deafness. In each ear there was a large collection of wax, on the removal of which the symptoms somewhat abated. The membrana tympani of both ears was white. Air passed freely into the tympanic cavities. The fifteenth of a grain of hydrargyri bichloridum thrice a day was prescribed, and counter-irritation around the ears. In the course of six weeks the patient had perfectly recovered.

Case IV.—Lady R., aged 62, consulted me in December, 1848, for a deafness which had come on during the preceding month, and gradually increased, till, by the time I saw her, it was requisite to speak loud and close to the ears. The deafness had first been perceived after a cold, and was accelerated by an attack of influenza. The feeling in the right ear was that of a veil hanging over it. In each ear the membrana tympani was white, and air passed freely into the tympanic cavities. The treatment pursued consisted in the application of a solution of argenti nitras to the outer half of the external meatus; beginning with the strength of half a drachm of the salt to an ounce of distilled water, afterwards increasing it to double that strength. This course of proceeding, coupled with the administration of alterative doses of pilula hydrargyri, effected so great an improvement, that in two months this lady had no difficulty in hearing in ordinary society.

Case V.—Mrs. A. T., aged 67, consulted me in April, 1845.

She stated, that when eight years of age, she fell down on the *left ear*, and had been deaf of that ear ever since. About four years ago loud internal noises disturbed the right ear, and increased to so distressing a degree, that this lady felt as if she were continually travelling in a carriage over gravel; and at times a loud explosion would be heard, succeeded by acute pain. She can scarcely hear her own voice, and is obliged to use a trumpet in society. The ears seem to her stopped up with pegs. She attributes this deafness to a close attendance in the sick-room of her husband during a long illness.

Right ear. — Membrana tympani concave, and evidently nearer to the promontory than natural; and the membrane is so white that the malleus is not distinguishable. *Left ear.*— Membrana tympani has been entirely removed by ulceration.

Treatment.—In the first instance leeches were placed immediately below the ear; tincture of iodine was applied to the external meatus of the right ear; and three grains of pilula hydrargyri were given every night.

June 3rd.—Feels much better; has less confusion in the head, and more confidence in herself.

June 15th.—The noises are so much diminished that she is no longer troubled by them; is feeling stronger and better, and the hearing improves.

Case VI.—J. C., Esq., aged 64, consulted me in November, 1844. His father became deaf at the age of fifty, and he has a sister deaf. About a year ago, he found that he was deaf in the left ear; might have been deaf a longer time; but at the period mentioned, a singing commenced in the left ear, which has continued without intermission ever since. Occasionally it is much diminished. The noise and deafness are much worse during a cold. The right ear is not so bad as the left. When he closes the right ear, he cannot hear any sound naturally.

Right ear.—Membrana tympani opaque, and the handle of the malleus only just discernible. When air is forced into the tympanum it can be heard by the otoscope entering it in a series of small puffs. After the air has been forced into the tympanum, a crackling sensation is experienced. Hearing distance two inches.

Left ear.—Membrana tympani white; handle of malleus indiscernible; air enters the tympanum in a short puff. Hearing distance absolute contact.

For this gentleman two grains of the pilula hydrargyri were prescribed, to be taken every night; and tincture of iodine was applied behind the ears. In the course of three months I saw him again, and found the hearing decidedly improved; the noises also had diminished.

Case VII.—Mrs. R. N., aged 64, consulted me August 2nd, 1844. For the preceding four or five months deafness had been coming on, and had lately so much increased that she finds it difficult to hear any conversation. Has for several years been subject to occasional dulness of hearing. The present deafness was apparently produced by an attack of cold, which left a sensation of fulness in both ears. The membrana tympani of each ear is quite white.

Treatment.—One-twentieth of a grain of hydrargyri bichloridum, in conjunction with vinum ferri, was administered thrice a day. The dose of bichloride was subsequently increased to one-sixteenth of a grain, and a solution of argenti nitras, half a drachm of the salt to an ounce of distilled water, was applied to the outer half of the external meatus. In the course of three months this patient recovered her hearing, and has remained quite well ever since.

(*b.*) MEMBRANOUS BANDS IN THE TYMPANIC CAVITY.

Membranous bands are formed in every part of the tympanic cavity, connecting together the ossicles, and attaching them to the walls of the tympanum and to the membrana tympani. In cases where these bands are lax, it is probable that the movements of the ossicles are not impaired, and that there is no diminution of the power of hearing. In the majority of instances, however, these membranous bands are so firm and unyielding as to cripple the movements of the bones to which they are affixed. On reference to the table it will be seen that these membranous bands most usually connect the stapes with the promontory, and thus produce one species of anchylosis of that bone. These adhesions originate either from the effusion of fibrin from the surface of the membrane, and its conversion into a firm and vascular membrane, or from the circumstance that when the mucous membrane is much hypertrophied, there is an adhesion of the

portions of it which are in contact, and the neighbouring parts are drawn into bands, when the membrane subsides to its normal condition.

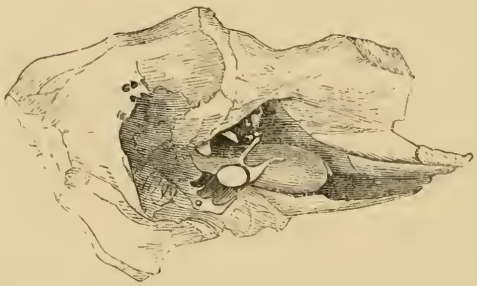
Care should be taken to distinguish between bands formed of organised membrane, and those which are produced by dried mucus, as pointed out by Mr. Hinton in the paper before alluded to.

Let me now relate the results of some dissections of cases in which these bands were found.

Case I. *Considerable hardness of hearing for six years; bands of adhesion in the cavity of the tympanum.*—Mrs. L. died in December, 1848, at the age of 87, from a gradual decline of the vital powers. Until the age of 50, she had no symptoms of derangement of the function of hearing; but about that period she was in the habit of taking "cephalic snuff," which she thought produced a buzzing sensation in her ears, a symptom which disappeared as soon as the use of the snuff was discontinued. At that period there was no sign of deafness; but about the age of 81, she perceived that the sense of hearing was becoming blunted. From that time deafness gradually and very slowly increased, attended now and then with noises in the ears. The deafness would be temporarily increased by a cold, but, as that vanished, the usual amount of hearing returned. During the last year of her life the disease made but little progress, though the deceased was obliged to use a speaking-trumpet for the purpose of conversation. It was observed that the sense of hearing became much more acute during the last few days of her life. This lady took very little exercise during the ten years preceding her death, but kept within doors, and sat in a warm room the greater part of every day. She was troubled with a chronic inflammation of the mucous membrane of the eyelids, lachrymal sacs, and nasal ducts. It is worthy of notice that this lady had two sisters, one of whom died at the age of 90. She was a very active person nearly up to the period of her death, and was but slightly deaf. The other sister, at the age of 89, is extremely deaf, and has been confined to her room for years.

Dissection. Right ear.—The external meatus was dry and deprived of cerumen. The membrana tympani has its fibrous layer slightly thickened and white, and is more concave than natural. *Tympanic cavity.*—The mucous membrane appears to

be healthy, and not thicker than natural, but there are bands of adhesion by which the ossicula are connected together and with the walls of the tympanum. These bands of adhesion may be divided into two distinct sets; one placed between the incus and the inner wall of the tympanum and stapes, and the other connecting the head of the malleus and the body of the incus with the external wall of the tympanum. The first-named set con-



MEMBRANOUS BANDS CONNECTING THE OSSICLES.

sists of two portions, of which the one, measuring half a line from above downwards, and three quarters of a line from without inwards, connects the anterior part of the long process of the incus with that part of the wall of the tympanum which is posterior to the fenestra ovalis. This band is connected by several smaller ones to the superior surface of the stapes, and also to a fine membrane which connects the two crura of the latter bone. These small bands are so firm and so tightly stretched between the stapes and the larger band, and between the incus and the inner wall of the tympanum, as to keep the stapes more fixed than natural. There are also adhesions between the upper surface of the crura of the stapes and the margin of the fossa fenestræ ovalis. The outer portion of this band extends from the posterior part of the long process of the incus to the inner wall of the tympanum, posterior to that just described: this band is also firm and tense. The second set of adhesions passes from the head of the malleus and the body of the incus directly outwards, connecting them with the osseous walls of the tympanum, superior and posterior to the attachment of the membrana tympani. It is interesting to consider what effect these bands must have had upon the ossicula and membrana tympani during life. Those which surround the stapes and connect it with the fossa fenestræ ovalis, must have

impeded the movements of the stapes; and those which connect the long process of the incus with the inner wall of the tym-

MEMBRANOUS BANDS CONNECTING THE OSSICLES TO THE PROMONTORY. (MAGNIFIED.)

panum, by pulling that process inwards would probably have been the means of pressing the stapes towards the vestibular cavity. The effect of the adhesions between the bodies of the malleus and incus, and the outer wall of the tympanum, would seem to have been to draw those parts outwards, and, in consequence, their inferior extremes inwards. This action upon the malleus is apparent, and may account for the greater concavity of the membrana tympani externally; it having been carried inwards with the long process of the malleus and being very tense. The bone of the stapes is also fixed more firmly than is natural to the margin of the fenestra ovalis. The membrane of the fenestra rotunda appears to be in a normal state. The membranous labyrinth is healthy; and except that there is rather more black pigment than usual in the cochlea of the left ear, it is in a similar condition to the right ear, and presents adhesions connecting the ossicula.

Case II. *Membrana tympani very concave externally; bands of adhesion connecting the ossicula together and to the tympanic walls.*—Mrs. F. O., died of gangrena senilis, at the age of 62. She had been deaf for a considerable period previous to her death, especially in the left ear.

Dissection. Right ear.—The membrana tympani is unusually concave externally, and the central part of its internal surface is not more than a quarter of a line from the promontory; it is also rather opaque in parts, especially at its circumference; and its internal layer is white, and slightly hypertrophied. The mucous membrane of the tympanic cavity is rather thicker and more vascular than natural, and is very tough. A firm band of

adhesion connects the cervix of the malleus with the long process of the incus, and another membranous band of adhesion connects the anterior surface of the long process of the incus with the promontory and with the stapes, which latter bone it completely envelopes. The tensor tympani muscle is smaller than natural.

Left ear.—Although the surface of the membrana tympani is smooth, it is white around the line of attachment of the malleus; the blood-vessels are enlarged and much distended with blood. The membrana tympani is more concave externally than natural. The cavitas tympani is three parts filled with a thick, tenacious, white mucus, which is partly the cause of the white appearance of the membrana tympani, though the inner layer of the membrana tympani being opaque and white, aids in producing this effect. The mucous membrane lining the tympanum is thick and very vascular.

It is not possible to distinguish, during life, between the cases of rigidity of the tympanic mucous membrane, and those of adhesions in the tympanic cavity; but as the treatment in both cases is the same, the distinction is not of much importance.

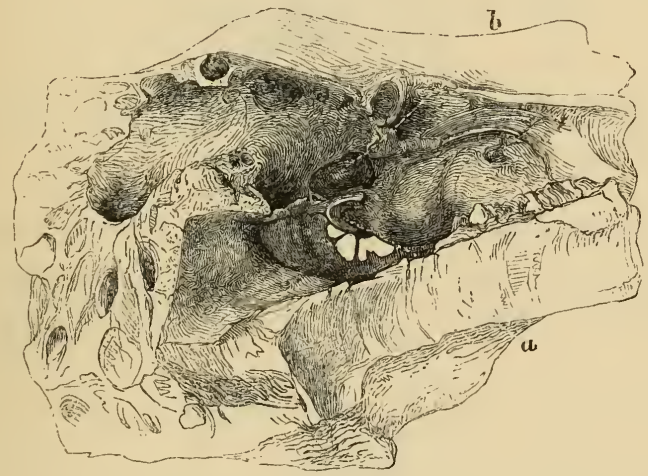
(*c.*) ANCHYLOSIS OF THE STAPES TO THE FENESTRA OVALIS.

In the published catalogue of the preparations contained in my museum, I have described one hundred and thirty-six specimens of anchylosis of the base of the stapes to the fenestra ovalis: and these specimens form the basis from which the pathology of this articulation has been studied.

In a tabular view of the morbid appearances found in 1149 diseased ears, published originally in the *Transactions of the Royal Medical and Chirurgical Society*, and afterwards as an appendix to the catalogue of my museum, fifty-three specimens of membranous anchylosis are described, specimens in which the stapes was attached more firmly than natural to the circumference of the fenestra ovalis; that is to say, upon the stapes being pressed by a fine probe, more than usual resistance was offered before the stapes moved. Now, in these cases, no expansion of the base of the stapes, or of the articular surface of the fenestra ovalis, was observed: and the only inference that could be drawn was, that these were cases of partial anchylosis of the stapedio-

vestibular articulation, resulting from rigidity of its capsular ligaments; and I am disposed to think, that this rigidity of the fibrous tissue is one of the earlier and more remediable stages of anchylosis of this and other articulations, which, if allowed to proceed, ends in the formidable pathological conditions known under the name of *rheumatic arthritis*, and which are about to be more particularly described.

The *second* morbid change found in this articulation is a simple expansion of the articular surfaces, while the structure of the bone itself remains, as far as can be ascertained, in a natural state. This morbid condition of the articular surfaces was found in *forty-nine* out of the one hundred and thirty-six cases of anchylosis; and was distinguishable from membranous anchylosis by the greater degree of firmness with which the stapes adhered

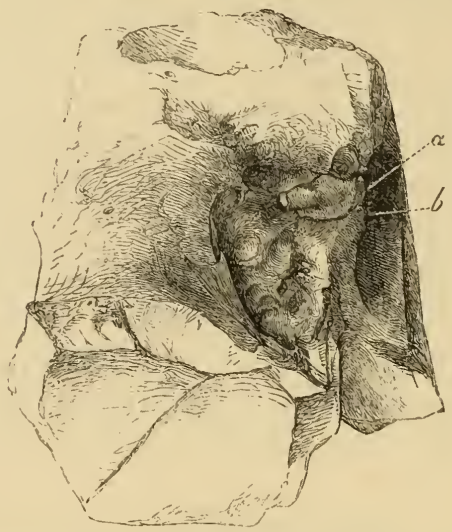


THE WHOLE OF THE CIRCUMFERENCE OF THE BASE OF THE STAPES ANCHYLOSED TO THE FENESTRA OVALIS, THE CRURA BEING DETACHED, AND SEEN BELOW. *a*, THE BASE OF THE STAPES; *b*, THE CRURA. (MAGNIFIED TWO DIAMETERS.)

to the fenestra ovalis, and by the presence of a distinct tumefaction of one or other articular surface, but generally of the stapedial.

The *third* pathological condition is that in which the whole of the base of the stapes has become hypertrophied, and assumed a calcareous whiteness; the border being so much enlarged as to be impacted within the fenestra ovalis with that degree of firmness, that the crura are often broken from the base in the attempt to withdraw the latter from the fenestra ovalis. In some instances, this expansion of the base of the stapes is accompanied by its protrusion into the cavity of the vestibule; still

there appears, even in these cases, to be nothing more than hypertrophy and condensation of the normal osseous structure. This morbid condition shows itself in *twenty-nine* specimens.



BASE OF THE STAPES EXPANDED, AND OSSEOUS MATTER THROWN OUT AROUND IT AND THE CRURA. *a*, THE STAPES; *b*, THE CAVITY OF THE VESTIBULE. (MAGNIFIED TWO DIAMETERS.)

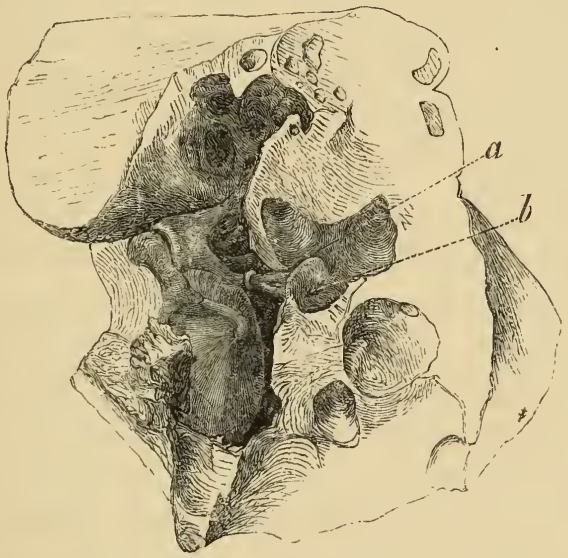
The *fourth* pathological condition is that in which the base of the stapes is greatly expanded, and new osseous matter is

EXPANSION OF THE BASE OF THE STAPES, AND ITS PROTRUSION INTO THE CAVITY OF THE VESTIBULE. (MAGNIFIED.)

thrown out beyond the natural limit of the bone, so as to connect the stapes with the adjacent parts of the fenestra ovalis; a morbid condition which is seen in *twenty-five* specimens.

The *fifth* pathological condition is that in which the structure

of the base of the stapes undergoes little or no alteration: but where ossific matter is thrown out at its circumference, and the base is thus partially or wholly anchylosed to the fenestra ovalis. This morbid condition is shown in *twenty-one* specimens, in eight of which the lower border only was anchylosed; there being a distinct space between the upper margin of the base and the fenestra ovalis: while in *thirteen* others, the whole circumference of the base is firmly anchylosed to the fenestra ovalis.



EXPANSION OF THE VESTIBULAR SURFACE OF THE ARTICULATION. (MAGNIFIED TWO DIAMETERS.) *a*, THE UPPER MARGIN OF THE STAPES FREE; *b*, THE LOWER MARGIN OF THE STAPES ANCHYLOSED.

The *sixth* pathological condition consists in the expansion of the vestibular surface of the articulation, and the effusion of bone around the fenestra ovalis, the stapes remaining perfectly healthy; an abnormal condition which occurred in twelve instances.

The five morbid conditions last described, comprised in 136 specimens, may be summarily stated in this form:—

1. Simple expansion of the articulating border of the base of the stapes	49
2. Expansion of the articulating border of the base of the stapes with calcareous whiteness of the whole base	29
3. Expansion of the whole of the base and effused bone connecting the two articulating surfaces	25
4. Osseous matter effused between the stapes and fenestra ovalis connecting the two articulating surfaces	21
5. Osseous matter effused around the fenestra ovalis	12
	136

DIAGNOSIS AND PROGNOSIS.

The diagnosis of this affection is, in the majority of cases, attended with little difficulty, if the origin and progress of the affection be carefully investigated, and the organ be examined with sufficient accuracy. The symptoms, in fact, of this class of disease are very similar to those occurring in cases of rigidity of the mucous membrane, already described. After a certain duration of these symptoms, sometimes for many months, the patient is found to be growing gradually deafer and deafer, frequently without any other marked symptom, though often there is a feeling of fulness or pressure in the ears, or a buzzing sound when laying the head upon the pillow. The progress of the affection is at first usually slow; at intervals of two, three, four, or more months, the patient observes the deafness to be decidedly on the increase, though mitigated temporarily perhaps by his resorting to very violent exercise, or by taking spare diet or aperient medicines. If the progress of this affection be left unchecked, total deafness results, and may take place at an early period of life, as between the ages of twenty and thirty, though commonly it does not happen till a much later period. Sometimes the affection advances so far as to produce a certain degree of deafness only, as where the patient has to be addressed in a loud voice within a yard or two of his ear, and then, from some constitutional change, no further progress takes place. An interesting symptom frequently met with in cases of this disease is the momentary improvement of the hearing produced by the acts of yawning widely, or pulling the outer ear, or pressing the tragus hard and quickly against the orifice of the meatus; each of which actions is followed by a temporary relaxation of the membrana tympani and chain of ossicles. In the case of yawning, I am disposed to believe that this relaxation is produced by the mechanical action of the chorda tympani nerve, which, being drawn tight, slightly pulls out the chain of ossicles. Another and peculiar symptom, is the effect produced by very loud and sudden sounds, as in two of the appended cases. In one of these, where, doubtless, the stapes was fixed by the expansion of its border, a loud scream in the ear at once restored the hearing by, as it would seem, suddenly releasing the bone; a restoration which lasted for several days, until, in fact, the two

again became fixed : in the other, a very loud sound of bagpipes in the patient's hall, where he was sitting, so increased his deafness, that his friends were obliged temporarily to use a slate and pencil to communicate with him. This increase of deafness also disappeared, and the patient recovered his previous amount of hearing.

A third interesting and very common symptom of the early stages of anchylosis of the stapes, is the loss of what I am in the habit of calling the *adapting power* of the organ. Thus the patient will hear perfectly a single distinct voice, but a second voice intermingling, completely disables him from hearing either; he having lost the power of rapidly adjusting his ear to suit the sound of the voice of the person immediately addressing him to the exclusion of that of the other. Yet another striking symptom of the early stages of the affection, is the necessity of exercising an act of sustained volition, in order to catch the sound of a voice, which ceases to be perceptible as soon as the effect is relaxed. It has, indeed, happened to me to receive patients whose complaint consisted not in being dull of hearing, since they could hear everything said in a room, but in not being able to do this without a prolonged effort of attention, the fatigue of which soon became intolerable. This latter condition is, of course, perfectly explicable, from the more or less rigidity of the chain of bones in this disease, and the muscular effort consequently required to move it and keep it in constant motion.

Another symptom, and one certainly characteristic of the later stages of this affection, but which it is not in my power to deny may not also be present in another disease of the ear, is the immense improvement to the hearing which attends the patient's travelling in a carriage over a hard road, by which considerable vibration is communicated to his body,—a vibration that doubtless in a degree shakes the chain of bones, and imparts to them a kind of vibratory movement, which permits the muscles, while it lasts, so to act on these bones as to restore more or less of their proper functions in adjusting the pressure on the labyrinth.

On examining the patient, there is usually abundant evidence of the rheumatic or gouty diathesis having been or being present, such as congestion or tumefaction of the nasal and faucial

mucous membranes, and, in addition, hypertrophy of the tonsils in young persons. On inspecting advanced cases, there is usually an absence of cerumen from the external meatus, the result of the congestion of this part of the organ, of which the membranous meatus presents most characteristic symptoms, in being red and so swollen as generally to have lost its oval form and to have become, in parts, constricted. Thus the upper half of the tube may retain its normal size and shape, while the lower may be reduced to a narrow fissure only one-half or one-third of its proper dimensions. Sometimes this diminution of the calibre of the meatus arises from a bulging of the bone forming the walls, so as to become a convex protuberance; in other instances, these osseous protuberances are so prominent as to gain the name of tumours, and as such they have been described in treating of the meatus.

The dermis covering this bone is usually of a deep red colour; indeed, as a rule, the dermoid meatus is highly congested in cases of gouty and rheumatic affections of the ear. The condition of the *membrana tympani* does not afford much aid in forming a diagnosis, though as a general rule, to which there are many exceptions, it is somewhat more opaque, and its surface duller than natural. Often it is very opaque, and white as parchment, and not unfrequently it exhibits patches of opacity in different parts. Occasionally the membrane is more concave externally than is natural. In advanced cases, like those where the base of the stapes has become fixed, the membrana tympani is rigid. The presence of this rigidity is, however, difficult to ascertain by simple pressure on the surface; but its existence may be proved by the use of the otoscope, while the patient either swallows with closed nostrils, or forces the air into the tympanic cavity by blowing the nose forcibly, the nose and mouth being at the same time closed. In each of these acts the air is heard to enter the tympanic cavity, for the Eustachian tube in these instances is usually open; but in place of the fine crackling sound elicited by these operations, when performed on a healthy ear, a flapping, or coarse crackling, is heard, produced by the air striking against the inner surface of the unyielding or tense drum. A yet further symptom of this disease is, that the patient commonly hears better in proportion to the loudness of the speaker's voice; whereas, in cases of debility of the

nervous apparatus of the ear, it is not the loud voice, but that which is peculiarly modulated which is heard the best, occasionally even when as low as a whisper. In addition to the foregoing symptoms, the existence of anchylosis of the stapes may be diagnosed by a careful attention to the causes producing it, and to the stages of its progress, which offer so marked a contrast to cases of debility of the nervous apparatus, with which cases of anchylosis of the stapes may, doubtless, otherwise be confounded.

With regard to the *prognosis*, it may be laid down, as a general rule, that so long as the affection depends upon rigidity of the ligaments, or upon a slight expansion of the basis of the stapes (and the surgeon can judge of the existence of these conditions during life by the symptoms being but little advanced), then there is every prospect that considerable amelioration may be effected, and the patient, in fact, be enabled to hear without any inconvenience, for experience has taught me that a rigid ligament may be relaxed, and an expanded bone be reduced in size. I may even venture on the further statement, that, judging from the visible diminution of the bony tumours in the external meatus under the influence of remedial measures, and taking into account also the decided improvement which at times takes place in cases where, from the symptoms, there was every reason to believe that the stapes or vestibule had become similarly expanded, there can be but little doubt that, even in the more advanced stages of anchylosis by expansion, some benefit can be obtained by the use of remedies which shall cause the effused matter to be absorbed. The more hopeless cases are those in which the opposing articular surfaces of the stapes and vestibule are united by ossific matter; and at present I am unaware of any means by which they can be diagnosed and discriminated from cases of anchylosis by expansion of the articular surfaces.

Treatment.—The treatment in these cases differs in no essential respect from that recommended for cases of rigidity of the fibro-mucous membrane.

Case I.—Mr. W., aged 47, consulted me, in the year 1848, on account of the state of his health, which was greatly impaired by attacks of rheumatic gout and congestion of the liver. When I saw him, he was so deaf that he required to be loudly spoken to, within the distance of a yard from his head. His

habits were far from being temperate, as he indulged freely in alcoholic drinks. The history of his deafness was, that many years previously he had gradually become dull of hearing, and that this dulness had increased slowly up to the period of my seeing him. The only occasion upon which he had been temporarily benefited, was on the removal of a large mass of cerumen from the meatus. I did not examine the ears, as I was not consulted on account of the deafness; but this omission is supplied by the particulars of the *post mortem* inspection. After having known him for a few years, he died from an attack of inflammation of the lungs.

Dissection. Right ear.—The meatus externus was somewhat contracted, the lower part being rough, and the surface irregular. The membrana tympani was thicker, and more opaque and rigid than natural; the chain of ossicles formed so solid a bridge between the membrana tympani and the vestibule, that considerable pressure on the handle of the malleus at the outer extremity of this bridge was requisite to produce the slightest movement of the chain. In the lower part of the tympanic cavity, a white deposit adhered to the surface of the bone, and was so closely incorporated with the fibro-mucous membrane, as to render it difficult to pronounce whether it was in the substance of, or below, the membrane. The base of the stapes was somewhat expanded, and its circumference was perfectly anchylosed to the fenestra ovalis. This anchylosis was partly effected by the expansion of the bone of the stapes, and partly by the effusion or prolongation from it, especially at the posterior part, of hard white matter.

Left ear.—The meatus externus was contracted, presenting at its posterior part a bulging of bone, and at its inferior part being very narrow. The membrana tympani was opaque, and the chain of bones as rigid as in the right ear. The head of the malleus presented small nodosities, similar to those on the heads of other bones affected with rheumatic gout. The stapes was perfectly anchylosed to the fenestra ovalis by the expansion of its base, and by the presence of a large quantity of hard white matter which surrounded it. The cavity of the vestibule contained also a great deal of white matter, similar to that in the right tympanic cavity.

In another case somewhat analogous in its morbid condition

to the foregoing, and in which the deafness and anchylosis were equally complete, the patient died with consumption under the care of Dr. Sibson, in St. Mary's Hospital, at the early age of 20, clearly showing that this affection is not necessarily the accompaniment of advancing years.

Case II.—Mr. L. J., aged 90, in good health, except that he suffered from attacks of gout, often complicated with rheumatism. About the age of 40, he found a dulness of hearing gradually coming on, which as gradually increased, until, at the time I saw him, he could only hear the voice when loudly spoken to close to the head. This gentleman had no desire for any treatment to be pursued, and I merely diagnosed the affection from the history of the case,—its slow, insidious progress, the absence of all symptoms of nervous debility, and the attacks of gout with which the patient was troubled. My opinion, thus formed, was that the cause of the deafness was anchylosis of the stapes; an opinion that I expressed to his medical and other friends. He died, some years after my first seeing him, of gouty inflammation of the bladder, and the opportunity was afforded me of carefully dissecting both petrous bones.

Right ear.—Meatus externus. At the posterior and upper part there was a distinct, smooth, and rounded projection of the bone, which extends obliquely from without and below, inwards and upwards, and is continuous with the rough scabrous portion of bone which forms the lower part of the meatus externus at its orifice, and is quite distinct from the mastoid portion of the bone. This projection measures about three lines from above downwards. At the upper part of the meatus the bone is rough and hypertrophied.

The membrana tympani was more concave externally, and much thicker and more opaque than natural. It was so rigid that pressure upon the outer surface of the malleus by means of a fine probe was not followed by any movement of the chain of bones. Upon laying open the tympanic cavity and pressing upon the stapes, this bone was found to be so compactly attached to the inner wall of the tympanum, that upon pressure there was not the slightest degree of movement. A broad membranous quadrilateral band entirely filled the space between the long process of the incus, the internal wall, the stapes, and the posterior wall of the tympanum. On laying open the vestibule,

the base of the stapes was observed to be of a white calcareous aspect, and perfectly united to the circumference of the fenestra ovalis by calcareous matter. The membrane of the fenestra rotunda appeared to be healthy, except that it was, if anything, slightly thicker than natural.

Left ear.—The meatus externus presented a bulging similar in shape and direction to that in the right ear, though somewhat larger. The membrana tympani was thicker and more rigid than natural, but not more concave externally than usual. The difference in the degree of concavity of this membrane in the two ears was so decided, that the inner surface of its central part, in the right ear, was one-third nearer to the inner wall of the tympanum than it was in the left ear. The stapes was firmly fixed, and its base, when the vestibule was opened, was found to be expanded and completely anchylosed to the fenestra ovalis.

Case III.—Mr. T. L. J., aged 50, of a gouty diathesis, the son of the above patient, consulted me, in 1852, on account of gradually increasing deafness. When I saw him, he had to be loudly spoken to within the distance of a yard of the head. He stated that the deafness had come on very gradually without any pain or uneasy feeling in the ears, and that no relief was ever experienced except from taking long walks, and perspiring very copiously. On *examination*, the membrana tympani in each ear was somewhat opaque, and the Eustachian tube pervious ; the air entering in a loud puff. The history of the case, and its similarity to that of the father, made me sure that the cause of deafness was anchylosis of the stapes. I laid down certain rules to be carried out, but on account of the sedentary nature of the patient's occupation, they could not be observed; attacks of gout became more frequent, and total deafness ensued.

Case IV.—Mr. N. C., aged 60, a man of intemperate habits, gradually became deaf at the age of 24. The deafness slowly increased to the day of his death, which took place at the age of 60, from an attack of bronchitis. There was hereditary deafness in this gentleman's family, several sisters and brothers becoming slowly deaf about the same age as did this patient. For some time previous to his death, the patient's right ear was useless, but, by means of a trumpet, he could manage to hear loud conversation addressed to him in the left.

Dissection of right ear.—(This dissection was made by Mr. A. Nopper, who kindly forwarded to me the specimen and his notes.) Membrana tympani more opaque than natural. Numerous transparent, membranous bands traverse the tympanic cavity. The ossicles were in a healthy state, with exception of the stapes, the crura of which had disappeared.* The fenestra ovalis was closed by the base of the stapes, which projected slightly into the cavity of the vestibule. In the vestibular cavity surrounding the fenestra ovalis, was a white mass of bone, which formed an annular protuberance around the interior two-thirds of the fenestra ovalis.

Case V. *Partial anchylosis of the stapes temporarily cured by the effect of a loud shout in the ear.*—The Rev. L. D., aged between 50 and 60, saw me in the year 1856, but not on account of his deafness, for which he did not seek advice; I, however, was able to glean the following interesting details of his case. The general health of this gentleman was good, with the exception of attacks of indigestion and rheumatism, which caused him great inconvenience. In a letter to me, he says, "I have had rheumatism in the shoulder-joint, which I always walked off, the pain becoming much aggravated as I got warmer, but being always at last driven out. I suffered for some weeks, three winters ago, from extreme weakness in both ankle-joints, so that I could scarcely go about my parish work. My friends assured me that it was the beginning of creeping paralysis, but I was sure that the stomach was the enemy. My work must be done, and I gradually walked my legs back into use." Deafness in the right ear appeared to have come on suddenly a few years before my seeing the patient, when the left ear was puzzled to know the direction of sounds. "I had no conception," he writes, "whence sounds came, until by degrees the left ear learnt to put sounds into their right places, or rather to settle the place of the cause of sound." No treatment was adopted, and the patient for some years remained in the same condition, the left ear being useless, or nearly so, and the right remaining tolerably perfect. In the year 1856, while this gentleman was superintending his Sunday-school, he was called upon to seize a boy who was endeavouring to bite his teacher, when, to use the

* It is probable that the crura of the stapes had been accidentally disconnected from the base in the act of dissecting the ear.

clergyman's own words, "he (the boy) sent such a yell into my right ear, that I heard not only the yell, but for some days I heard all other sounds most distinctly, when it, the hearing, again relapsed, and my left ear had again to learn its duties." From the history and examination of this case, I have no doubt that the affection consisted of rheumatic disease of the stapedio-vestibular articulation, and that the morbid condition was no other than that peculiar expansion of the base of the stapes so frequently adverted to. The effect of the loud scream was doubtless to release the stapes for a time, so as to allow of its movement by its muscles. It may here be added, that in another patient, who was under my care for some time for deafness produced by rheumatism of the ears, an exactly opposite effect, viz. complete deafness, was temporarily produced by a sudden loud sound. This gentleman was quite deaf in one ear, but with the other heard a loud voice, when distinctly spoken, at a short distance from him. In this condition he was subjected to the sudden shrill sound of bagpipes played in the hall where he sat, by which he was at once rendered too deaf to hear the human voice, and all communications to him were obliged to be in writing. This increased deafness lasted for several days, and then the ear recovered the hearing power it possessed previous to the accident. There appears to be great probability that in the latter case the cause of the increased deafness was, that the stapes was driven inwards and held tight by the fenestra ovalis, and that the return of the hearing power was due to the release of the stapes.

(*d.*) DISCONNEXION OF THE INCUS AND STAPES.

An affection of the ear directly opposite to rigidity of the chain of bones sometimes takes place, and this consists in the disconnexion of the incus and stapes. I will preface my account of this affection by making some physiological observations bearing on the subject.

Physiological observations.—The opinion usually entertained is, that two channels are requisite for the transmission of sonorous undulations to the labyrinth from the membrana tympani; one channel being the air in the tympanic cavity, which conducts the undulations to the membrane of the fenestra rotunda

and the cochlea; the other channel being the chain of ossicles, which conducts the undulations to the vestibule.

That this opinion is not universally received is apparent from the following quotation from an authority highly deserving of attention, Mr. Wharton Jones. He says:—"Some physiologists assert that the sonorous undulations are communicated from the membrana tympani to the ossicles, and through them conducted to the vestibular fenestra; others suppose the undulations to be propagated merely through the air in the cavity of the tympanum, to the membrane of the fenestra rotunda; the ossicles and their muscles serving the purpose of regulating the tension of the membrana tympani, the membrane of the vestibular fenestra, together with the membranous labyrinth. A combination of the two views is most generally received. However well founded the view may be that sound is propagated through the chain of small bones, the circumstance that some degree of hearing may persist along with loss partial or complete of the membrana tympani, and of the malleus and incus, is a conclusive proof that sound may be conveyed through the fenestra to the labyrinth, by the vibrations of the air in the tympanum alone. It would appear also, that the integrity of one fenestra may suffice for the exercise of hearing."*

Mr. Brooke, whose views on questions of experimental science are worthy of the fullest consideration, has published his reasons for believing that it is not possible for the sonorous undulations to be conducted to the labyrinth by the chain of bones.

He says: "The transmission of sound cannot take place through the ossicula, as it was formerly supposed, inasmuch as the plane in which the crura of the stapes lie, is exactly perpendicular to the plane passing through the manubrium of the malleus and long leg of the incus; and consequently, the vibrations passing through them would be almost entirely intercepted by the stapes. And, moreover, it appears essential that the transmission of vibrations through the chain of ossicula should be prevented; for as the velocity with which sound is transmitted through solids, such as bone, so very far exceeds the velocity in air, if the same undulations reach the labyrinth through this channel, and through the channel previously described (the air

* Cyclopædia of Surgery. Article, "Diseases of Ear and Hearing," p. 23.

in the tympanum), they would reach in different times, and constant interference would be produced."*

Although Mr. Brooke has thus confidently expressed his opinion that "the transmission of sound cannot take place through the ossicula," his statement, unsupported by experiments and observations, does not seem to have induced writers on the physiology of the ear to adopt his conclusions. Thus Dr. Carpenter, in the latest edition of his Human Physiology, having referred to Mr. Brooke's paper, says:—"From what has been stated, it is evident that sonorous undulations in the air will be propagated to the fluid contained in the labyrinth through the tympanum, the chain of bones, and the membrane of the *fenestra ovalis* to which the stapes is attached without any loss, but rather an increase of intensity."†

Indeed, with a consciousness of the wonderful accuracy of M. Savart's experiments in acoustics, it appears impossible, without further experiment, to disbelieve the assertion he made in the following quotation from his writings:—"Les vibrations de la membrane se communiquent sans altération au labyrinthe par le moyen des osselets, comme les vibrations de la table supérieure d'un instrument communiquent à la table inférieure par le moyen de l'âme."‡

But supposing with Savart, that under ordinary circumstances sonorous undulations are conducted to the labyrinth by the chain of ossicles, is it also possible, under certain conditions, for the function of hearing to be carried on without the aid of these bones? Mr. Wharton Jones has answered this question in the affirmative, as he says, that "the integrity of one fenestra may suffice for the exercise of hearing;" and Sir J. Herschel inclines to the same opinion. He says: "These bones form a kind of chain, and no doubt vibrations excited in the tympanum by vibrating air, as in the experiments above detailed, are somehow or other propagated forward through these; but they are so far from being essential to hearing, that when the

* Report of a Lecture delivered at the Royal Institution; *Lancet*, 1843, p. 380.

† Page 733.

‡ Recherches sur les Usages de la Membrane du Tympan, et de l'Oreille externe. Journal de Physiologie. Par F. Majendie. Tome iv. p. 219.

tympanum is destroyed, and the chain in consequence hangs loose, deafness does not follow."*

My object at present is to attempt to ascertain,—

Firstly, whether sonorous undulations from the external meatus can reach the labyrinth without the agency of the ossicles; and,

Secondly, whether the chain of ossicles can conduct sonorous undulations to the labyrinth.

Firstly. Can sonorous undulations reach the labyrinth from the external meatus without the agency of the ossicles?

There can, I think, be no doubt but that the malleus and incus, and even the crura of the stapes, can be removed without the production of any very serious detriment to the hearing, but there is no well-authenticated case in which the base of the stapes has been removed in which total deafness did not ensue, but this deafness must doubtless be attributed to the removal of the fluid of the labyrinth at the time the stapes was withdrawn.

But what is the effect of a fixed condition of the base of the stapes? Now it happens that bony anchylosis of the base of the stapes to the margin of the fenestra ovalis is by no means a rare morbid condition, and I have had several opportunities of seeing patients with this affection during life, watching their symptoms, and subsequently dissecting the organ. The result of my observations is to demonstrate that simple bony coalescence of the base of the stapes to the wall of the vestibule is productive of so high a degree of deafness, that the sonorous undulations could reach the nerve only by passing through the walls of the cranium; and this statement accords with that of Dr. Pappenheim, who found merely "some degree of hearing" in a similar case. It may possibly be argued that the deafness occurring in cases of anchylosis of the stapes to the fenestra ovalis, may be accounted for by the fixed condition of the *membrana fenestræ rotundæ* which necessarily results, but I think it is palpable that the mere incapacity of this membrane to alter its state of tension would not be sufficient to account for the high degree of deafness to sounds (acute equally with the bass), which characterised the whole of the cases that have fallen

* Encyclopædia Metropolitana. Article, "Sound," p. 810.

under my observation. It may however be asked, is it not possible for sonorous undulations to reach the labyrinth without the aid of the stapes, since the function of hearing is but slightly impeded by the removal of the incus, and when consequently no vibrations can reach the stapes, except through the air in the tympanum? It seems indeed to have been assumed, that when the stapes is thus detached from the incus, it cannot receive vibrations from the air externally and conduct them to the vestibule; what grounds there exist for this conclusion will be seen from the following experiments.

That solid bodies are capable of being thrown into a state of vibration by the agency of sonorous vibrations existing in, and communicated by, the air, is a fact too well known to require demonstration; but the following experiments show how far the solid stapes, when isolated from the incus, may possibly receive vibrations from the air and conduct them to the labyrinth.

Experiment.—The ears having been closed, a piece of wood, five inches long and half an inch in diameter, was held between the teeth, and a vibrating tuning fork, C′, having been brought within the eighth of an inch of its free extremity, was distinctly heard, and it continued to be heard for between five and six seconds.

Experiment.—One end of the piece of wood used in the previous experiment being pressed gently against the outer surface of the tragus, so as just to close the meatus, a vibrating tuning fork, C′, placed within a quarter of an inch from the free extremity, was heard very distinctly at first, and it did not cease to be heard for fifteen seconds.

Experiment.—Three portions of wood, having the same length and thickness as those used in the above experiments, were glued together so as to form a triangle having somewhat the shape of the stapes. The base of this triangle being placed against the outer surface of the tragus so as to close the meatus, the tuning fork, C′, vibrating within a quarter of an inch from the free apex, was heard for twelve seconds.

From the above observations and experiments, I think it may be reasonably inferred *that the stapes, even when detached from the ossicles, if free to move in the fenestra ovalis, will receive sonorous undulations from the air in the tympanic cavity, and will conduct*

them to the labyrinth, and that there is no evidence that sonorous undulations can reach the labyrinth from the external meatus without the agency of at least one of the ossicles, viz., the stapes.*

I shall proceed to inquire, in the *second* place, whether the chain of ossicles can conduct sonorous undulations to the labyrinth.

In this second part of the inquiry, I shall endeavour to determine,

a. How far the sonorous undulations excited in the membrana tympani are intercepted in the chain of ossicles by "the plane in which the crura of the stapes lie, being exactly perpendicular to the plane passing through the manubrium of the malleus and the long leg of the incus;" and

b. To what extent the articulations of the chain of bones impede the passage of these undulations.

(*a.*) *To what extent are these vibrations, excited in the membrana tympani, arrested by the variation in the plane of the chain of ossicles.*

After M. Savart's conclusive experiments, repeated and verified by so many subsequent observers, it is needless for me to point out how freely sonorous undulations excited in the air, are communicated to a membrane like that forming the membrana tympani; nor how fully they are conducted from a stretched membrane, like the membrana tympani, to a solid attached to this membrane like the malleus, and free to oscillate. Assuming, therefore, that the vibrations reach the malleus, I will proceed to examine how far they are conducted through it and the other ossicles.

Experiment.—Three pieces of wood, each five inches in length and half an inch thick, were glued together so as to represent the planes of the three bones of the ear; while three other portions were glued together end to end, forming a straight rod. A watch was placed at one end of the straight rod, while the other end was applied against the tragus of the ear, which it pressed firmly inwards so as to close the meatus completely and to exclude sounds from entering the ear by it.

* The result of these experiments accords with the fact I have observed, viz., that an amount of hearing so efficient that the patient was not supposed to be deaf, or to have deficiency of hearing power, has been found to co-exist with isolation, apparently congenital, of the stapes from the incus.

The result was, that the watch was heard nearly as distinctly as when it was placed in contact with the ear; when a similar experiment was performed with the angular piece of wood representing the chain of bones, the watch was still heard, but less distinctly.

Experiment.—A tuning fork, C′, being made to vibrate, was placed in contact with one extremity of the angular piece of wood, the other being placed against the tragus of the ear; and when the straight portion was similarly used, it was found, as in the former experiment, that the sound was decidedly less loud when heard through the angular than through the straight portion; and after the sound had altogether ceased to be heard through the angular portion, the same tuning fork was heard for about three seconds, when the straight piece was substituted.

Finding that there existed some little difficulty in exercising the same amount of pressure on the tragus of the ear in each experiment, and considering that a variation in the amount of pressure might cause the air in the meatus to assume different degrees of density, I had recourse to the teeth as a medium for the transmission of the sound. I found that a solid placed in contact with the teeth of the lower jaw conducted vibrations with rather greater facility than when in contact with those of the upper jaw, and I therefore adopted the plan of holding the conducting body between the teeth.

Experiment.—A tuning fork, C′, was placed at one extremity of the angular piece of wood, the other extremity being held between the teeth; the fork was at first heard very distinctly, and when this sound could no longer be distinguished, the straight piece was substituted, and it was again heard for the space of two seconds.

Experiment.—Instead of the horizontal portion of wood representing the stapes, three portions of the same size were made into a triangle, and this was glued to the anterior surface of the inferior extremity of the piece representing the incus; the last experiment was repeated, with the substitution of this apparatus for the angular portion, and with very nearly the same result, viz., the fork was heard through the straight piece about three seconds after it had ceased to be heard by the apparatus representing the chain of bones.

Experiment.—A piece of iron wire, eighteen inches long and

about two lines in diameter, was bent so as to represent the different planes of the chain of ossicles of the human ear; the tuning fork, C′, was placed at one extremity, while the other was held between the teeth. The sound was heard very distinctly at first, and when it ceased to be heard, a straight portion of the same length was substituted, through which the tuning fork was heard for three seconds.

Experiment.—A piece of very thin paper was gummed over one end of a glass tube three inches in diameter. To the outer surface of this paper a model of the ossicula, similar to the one used in a previous experiment, was glued. A vibrating tuning fork, C′, being placed in the interior of the tube and within a quarter of an inch of the paper, the end of the chain representing the base of the stapes was placed between the teeth; the sound was heard distinctly, and it continued to be heard for ten seconds. The sound of the tuning fork, C″, was heard for twenty seconds.

The results of these experiments appear to indicate that the passage of sonorous undulations is somewhat, but only slightly, impeded by the variation of the plane in which the ossicles are placed.

I proceed, *secondly*, to consider the effect of the articulations between the ossicles, upon the passage of sonorous undulations through them.

The articulating surfaces of the small bones of the ear are usually described as being incrusted by cartilage, which is covered with synovial membrane. Professor Kölliker, speaking of these bones, says, "Their articulations and ligaments resemble in miniature those of other similar organs in all respects, even down to the cartilaginous layer, consisting of scarcely more than a single stratum."*

Before proceeding with the inquiry concerning the passage of sonorous undulations through the chain of bones, it is desirable to consider carefully the structure of their articulations.

They may be considered as *four* in number, viz. :—

1. The malleo-incudal.
2. The inco-orbicular.
3. The orbiculo-stapedial.
4. The stapedio-vestibular.

* Manual of Human Histiology. By Busk and Huxley. Vol. ii. p. 404.

(1.) *The malleo-incudal articulation.*

The convex surface on the lower and posterior part of the head of the malleus is received into the concavity on the anterior part of the body of the incus; when applied together, as they are retained by their ligaments in a natural state, the surfaces of these two bones appear to be in close contact. Upon examining the articulating surfaces of the malleus and incus in a recent specimen, by means of a lens magnifying five or six diameters, no appearance of cartilage can be detected; and when touched with a fine probe, the surface is felt to be hard, as if no membrane were present. If, however, these articulating surfaces be scraped with a small scalpel, fine pieces of transparent membrane are removed. Examined by the microscope, this membrane, in some parts, is seen to be homogeneous, having no appearance either of fibres or cells; in other portions, delicate fibres can be detected, while here and there a single layer of cartilage cells can be distinctly recognised. As a general rule, more cartilage cells are to be found in the membrane removed from the incus than in that from the malleus.

(2.) *The inco-orbicular articulation.*

The orbicular bone is sometimes described as a process of the incus. Careful examination of recent specimens shows, however, that the orbicular bone is connected to the incus by firm fibrous tissue.

(3.) *The orbiculo-stapedial articulation.*

The orbicular bone, on its surface towards the stapes, presents a slightly convex head, which is received into the superficial concavity on the head of the stapes. This convex surface of the orbicular bone is covered by a membrane, in which I have not been able to detect any cartilage cells. The outer extremity of the stapes is covered by a saucer-shaped cushion, soft to the touch; and upon examination by the microscope, it is seen to be a disk of fibro-cartilage, being a representation in miniature of those existing between the bodies of the vertebræ, the circumference being composed of fibres arranged concentrically around cartilage cells which occupy the central position.

(4.) *The stapedio-vestibular articulation*

is formed by the circumference of the base of the stapes, which is applied against the inner surface of the fenestra ovalis; the stapes, as I have shown, being moved by muscles to and fro in the fenestra ovalis, as a piston moves in a cylinder. I have not been able to detect any cartilage on the surface of either the base of the stapes or of the fenestra ovalis, a very fine membrane alone being discernible.

The articulating surfaces forming the several articulations, are connected together by very delicate capsular ligaments.

The next step of my inquiry was to ascertain by experiment how far these articulations tend to impede the passage of sonorous undulations through the chain of ossicles. As in the former experiments, these tympanic ossicles were represented by portions of wood; while the cartilage and synovial membrane were represented by layers of vulcanized india-rubber.

Experiment.—Three pieces of wood, each about five inches long and half an inch in thickness, were separated from each other by a piece of vulcanized india-rubber about as thick as ordinary writing-paper; they were held together by means of elastic bands, and so as to assume the angular form possessed by the chain. The tuning fork placed at the distal extremity of the chain, the other end being placed in the mouth, it was found that the sound was heard as distinctly, and for the same length of time, as when it passed through the chain formed of the three portions glued together.

Experiment.—A similar result took place when two layers of india-rubber were placed between each piece of wood.

Experiment.—When eight layers of the india-rubber were placed between each piece of wood, there was still very little difference in the intensity of the sound when it passed through these, and when it passed through the portions glued together.

Experiment.—One, two, or three fingers being placed between the first and second pieces of wood, and eight layers of india-rubber between the second and third, a very slight diminution in the intensity and duration of the sound was observed as compared with its passage through the pieces glued together, it being requisite that the fingers be pressed tolerably firm against the wood.

Experiment.—If the back of the hand be placed against the

teeth, and the end of the vibrating tuning fork be pressed against the palm, the sound is heard very distinctly for several seconds; and when it has ceased to be heard, if a piece of solid wood three inches long be substituted for the hand, faint vibrations are again heard, but for about four seconds only.

Considering the extreme tenuity of the layers of cartilage and synovial membrane which are interposed between the *ossicula auditûs*, and the very slight influence in arresting the passage of the sonorous undulations produced by layers of india-rubber, the inference is that *the articulations between the bones forming the chain in the human ear, impede very slightly, if at all, the passage of vibrations from the membrana tympani to the labyrinth.*

The experiments and observations detailed above lead to the following conclusions :—

First.—That the commonly-received opinion in favour of the sonorous undulations passing to the labyrinth through the chain of ossicles in the human ear, is correct.

Second.—That the stapes, when disconnected from the incus, can conduct sonorous undulations from the tympanic cavity to the vestibule.

Third.—So far as our present experience extends, it appears that in the human ear sound always travels to the labyrinth through two media, viz., the air in the tympanic cavity to the cochlea, and one or more of the ossicles to the vestibule.

After a detail of the above results, it will readily be assumed that a simple disconnexion of the incus from the stapes is not productive of any large amount of dulness of hearing. In the course of my dissections I have met with eight cases in which the incus was disconnected from the stapes, and in no instance could I trace deafness specially to this cause. Some of the patients from whom the dissections were taken were undoubtedly deaf, but their deafness could be assigned to other causes than the existence of the solution of continuity in the chain of bones. One of the patients in whom it occurred was not detected by the surgeon to be deaf; but this might arise from the fact that the lesion existed in one ear only. From some researches I have made on the subject, it appears probable that the cause of this peculiar lesion is hypertrophy of the mucous membrane of the tympanum; in cases of this disease, the supply of blood to

the substance of the incus being interfered with. It is important to recognise the existence of this disease, and to do all that is possible to avert it by subduing any thickening of the tympanic mucous membrane, but it remains for future investigations to decide to what extent this lesion interferes with the hearing power.

Case I.—A man, æt. 19; deaf in the left ear; died of apoplexy. In this ear the membrana tympani contained calcareous matter. The mucous membrane of the tympanum was very thick. The extremity of both long and short process of the incus had disappeared, and the surface of the adjacent bone was rough.

Case II.—A man, æt. 67. *Right ear.*—The inferior extremity of the long process of the incus has been absorbed, and the os orbiculare is attached to the stapes. On the inner surface of the head and long process of the incus are numerous orifices which lead into the interior of the bone, giving it a worm-eaten appearance.

Case III.—A boy, æt. 5; died from scarlatina, and was not known to be deaf. Right ear in a normal state. *Left ear.*—The os orbiculare is separated from the incus, and is attached to the stapes; the stapes is fixed to the fenestra ovalis more firmly than natural. The tympanic cavity contained mucus; lymph was also effused, and bands of adhesion between the membrana tympani and the inner wall of the tympanum were in process of formation. The whole of the inner surface of the long process of the incus presented a worm-eaten appearance, and its lower extremity has disappeared, apparently from absorption. The os orbiculare is attached to the neck of the stapes, the part usually attached to the incus being free and rough, and projecting somewhat from the neck of the stapes.

Case IV.—A boy, æt. 3½ years; died from dysentery; he was not ascertained to be deaf. *Right ear.*—The incus on the inner surface of its long process presented numerous foramina, and the orbicular process was partly absorbed, only a small rough portion of it remaining attached to the incus—the inner surface of the extremity of the process being hollowed out, and having sharp margins. *Left ear.*—The incus is in the same state as that of the right ear, and the larger part of the orbicular process is attached to the stapes.

CHAPTER XIV.

THE MASTOID CELLS.

ANATOMICAL OBSERVATIONS—(*a*) DISEASES OF THE MASTOID CELLS IN CHILDHOOD —CASES OF THE DISEASE ADVANCING TO THE BONE AND THE CEREBRUM. (*b*) DISEASES OF THE MASTOID CELLS IN THE ADULT—ACUTE INFLAMMATION OF THE MUCOUS MEMBRANE—CHRONIC INFLAMMATION OF THE MUCOUS MEMBRANE—PURULENT INFECTION—SYMPTOMS OF REMITTENT FEVER—CARIES OF THE LATERAL SULCUS—ABSCESS IN THE CEREBELLUM. (*c*) NECROSIS OF THE MASTOID PROCESS—PARALYSIS OF THE PORTIO DURA NERVE—TREATMENT. OPINION RESPECTING LIFE INSURANCE IN CASES OF DISCHARGE FROM THE EAR.

As regards their functions, the mastoid cells may be considered merely in the light of an appendage to the tympanic cavity; but their peculiar conformation and intimate relations with the lateral sinus render a special study of their diseases necessary, previous to entering on which it is, however, important thoroughly to understand their anatomical relations.

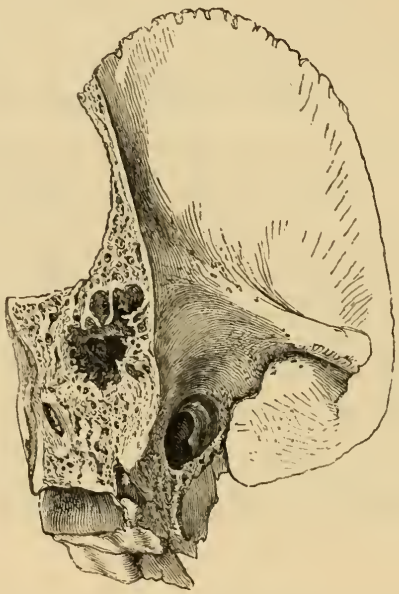
Anatomical observations.—Like the mastoid process, the mastoid cells vary much in size in different individuals. In some persons they occupy the whole of the interior of the bone behind the meatus externus for the distance of an inch and a half; their vertical diameter is two inches, and they extend inwards as far as the fossa jugularis; in other cases the mastoid process is almost solid, and the cells communicating with it are small and few in number. The mastoid cells may be considered as consisting of two portions: one contained in the mastoid process, where the cells have more or less of a vertical arrangement, the other situated between the mastoid process and the tympanic cavity: this latter portion is generally horizontal and frequently presents a concavity at its floor, in which mucus or other secretions are apt to lodge. On the inner surface of the mastoid process is the sulcus lateralis, which is occupied by the lateral sinus. Numerous orifices exist in this sulcus for

the passage of veins from the mastoid cells to the lateral sinus, which is generally the part first affected in disease of the mastoid cells occurring in the adult. These cells are bounded anteriorly by part of the posterior wall of the meatus. At birth, and during early life, the mastoid process is in a rudimentary state, and the only representative of the mastoid cells is the horizontal portion which is adjacent to the tympanic cavity; the extension of which backwards and downwards, in later periods, forms the cavity of the mastoid process. It is essential that the relations of this horizontal portion of the mastoid cells in the earlier periods of life should be well understood, since disease occurring in it then produces entirely different results from those of a later period. If a vertical section be made so as to pass through this horizontal portion in the temporal bone of a child about two years of age, these mastoid cells will be observed to be bounded externally by a part of the squamous bone, which is superior and slightly posterior to the

THE EXTERNAL SURFACE OF THE TEMPORAL BONE OF A CHILD. THE OUTER WALL OF THE HORIZONTAL PORTION OF THE CELLS HAS BEEN REMOVED, AND THE CAVITY OF THIS PORTION OF THE CELLS ABOVE THE MASTOID PROCESS IS EXPOSED.

meatus externus; and it is this particular part which becomes affected in cases of disease of the mastoid cells in early life. The upper wall of the horizontal portion of the mastoid cells is formed by a layer of bone, continuous with that of the upper wall of the tympanum. This lamina partakes of the disease of the cavity,

and thus the dura mater and cerebellum become liable to be affected when, in early life, disease occurs in the mastoid cells. Before the second year this cellular cavity is comparatively much larger than at a later period.



A VERTICAL SECTION OF THE TEMPORAL BONE OF A CHILD THROUGH THE HORIZONTAL PORTION OF THE MASTOID CELLS. IT IS SEEN TO BE BOUNDED EXTERNALLY BY THE LAYER OF BONE, WHICH HAS BEEN REMOVED IN THE PRECEDING CUT, AND WHICH USUALLY BECOMES CARIOUS IN CASES OF DISEASE IN THE HORIZONTAL PORTION OF THE CELLS IN EARLY LIFE.

The diseases of the mastoid cells in the child will be first described, and afterwards those in the adult.

(*a.*) DISEASES OF THE MASTOID CELLS IN CHILDHOOD.

The most frequent causes of disease in the mastoid cells, as in the tympanum, at this period, are scarlet fever, measles, small pox, and scrofulous affections. In the three former of these affections, the mucous membrane is usually the subject of chronic catarrh, becomes hypertrophied, and mucus collects in the cells. In the undeveloped state of the mastoid process in childhood, the mucus collects in the horizontal portion, bounded externally, as already described, by the squamous bone, and above by the continuation of the lamina forming the upper tympanic wall. Hence it is evident that the portions of bone liable to be affected by disease in the mastoid cells of the child, are the squamous bone immediately above and behind the

external meatus, and the posterior part of the upper wall of the tympanum. Dissection shows also that these two parts are in fact those which do become affected, and that in cases of disease attacking the mastoid cells in early life, the cerebrum is the part of the brain which suffers, while, as we shall see in later periods of life, the cerebellum becomes affected.

In disease of this part the discharge from the affected ear often dates from birth, and is generally at first unaccompanied by any pain; so that too often (especially among working people) no notice whatever is taken of it. In its earlier stages the discharge appears to be purely sympathetic, and, as in many other cases of irritation of the tympanic mucous membrane, it proceeds from the meatus and the outer surface of the membrana tympani. As the disease progresses, the tympanum becomes filled by mucus or scrofulous matter, and the membrana tympani yields to the pressure on its inner surface; and no doubt in some cases, if a thorough outlet be thus made for the discharge from the mastoid cells, while the health of the patient at the same time improves, no further mischief accrues; but unfortunately the peculiar conformation of this part of the mastoid cells usually prevents the free escape of the matter; part of it, at least, remains lodged in its concavity, or the whole is barred from exit by the closure of the tympanic cavity through the hypertrophy of the lining mucous membrane. In all fatal cases the discharge has been deprived of a free egress.

One of the peculiar features of the disease is, that it sometimes causes death, by producing general cerebral irritation rather than inflammation. In the first two cases* which follow, there was no appearance of disease in the brain, pia mater, or arachnoid; in the third case these parts were but slightly affected in comparison with the large amount of disease in the ear.

Case I. *Scrofulous disease of the horizontal portion of the mastoid cells before the first year of life; caries of the squamous bone; disease of the dura mater.*—J. R., aged thirteen months, was admitted under my care as an out-patient, at St. Mary's Hospital, on the 12th February, 1852. Although she had a good colour and was not thin, her mother stated, that since her birth she had never been strong, and that she had been brought up by

* A somewhat analogous case has been cited as having occurred to Dr. Chambers.

hand, on account of herself (the mother) having an abscess in one breast. The history was, that at six years old a discharge was observed to flow from the right ear, which had continued to the present time with but short intermissions. Three weeks ago an abscess formed at the back of the ear and discharged into the meatus. On inspection, the surface of the meatus was seen to be red, and its substance so much tumefied as to prevent its being ascertained whether the membrana tympani was or was not present. The discharge consisted of pus and mucus. The abscess behind the ear communicated with the meatus by an aperture at its posterior part. The ear was ordered to be syringed with warm water.

February 19th.—Symptoms much the same, but the discharge more offensive.

Until the 1st of April the symptoms gradually subsided, the discharge diminished, and the child appeared stronger. On the 2nd, however, the discharge grew more offensive, and less in quantity. On the 8th the child cried, as if in pain, and started in her sleep.

April 15th.—Leeches afforded some relief, and were ordered to be continued.

19th.—Has had shivering fits to-day. From this date the head symptoms gradually increased; the respiration became difficult, and the child died in convulsions on the 29th.

Autopsy.—The part of the sterno-mastoid muscle attached to the mastoid process was discoloured. The membranous meatus was much thickened, and of a dark purple colour. The posterior part of the osseous meatus was carious; and the bone continuous with and above it, for a space the size of a sixpenny-piece, was also carious; this being the portion of bone which bounds externally the horizontal mastoid space. The periosteum covering this carious bone is thick and soft in some parts, and ulcerated in others. There is also internally a portion of necrosed bone about one-half the size of that externally; and upon a section the inner surface is found to be part of the necrosed portion of bone which is seen externally, where it covers the tympanic cavity and extends above it. The outer surface of the dura mater which is in contact with the dead bone, is soft, spongy, and of a dark colour, and partly filled the superficial cavity formed by the necrosed bone: in immediate contact with

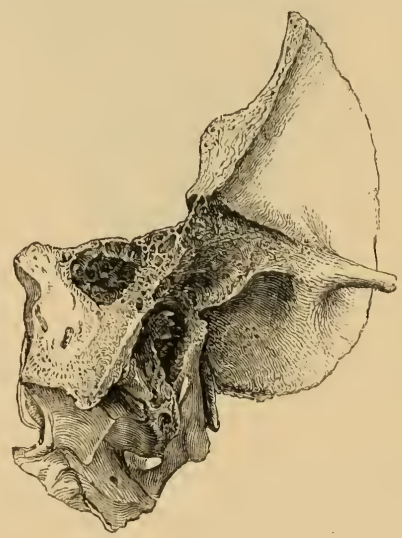
that bone, however, was a soft pulpy tissue. The membrana tympani was absent, the mucous membrane of the tympanum ulcerated, and the ossicles carious. The lungs were tuberculous, the mesenteric glands large, containing also scrofulous matter.

THE EXTERNAL SURFACE OF THE TEMPORAL BONE, SHOWING THE IRREGULAR-SHAPED CARIOUS PORTION OF BONE ABOVE THE MEATUS.

The following case is very analogous to the one just reported.

Case II. *Scrofulous disease in the horizontal portion of the mastoid cells in the first year of life; caries of squamous bone and disease of dura mater.*—E. B., aged sixteen months, subject to scrofulous glands, was admitted under my care at the St. George's and St. James's Dispensary, in November, 1849. When seen, there was a large abscess behind the left ear and discharge from the meatus. The membrana tympani was absent, the mucous membrane of the tympanum thick and red. At the bottom of an abscess behind the ear, dead bone could be felt. Her mother stated that there was discharge from the *right* ear at the age of three months, which lasted six or seven weeks, and then disappeared. When five months old, discharge took place from the *left* ear, and after continuing for a month, a swelling appeared at the back of the ear, which was opened and continued discharging, as well as the meatus, to the time I saw the patient. Soon after seeing her, the symptoms of cerebral irritation which had shown themselves at times in the form of great pain in the left side of the head, rapidly increased; and in face of all the remedial measures employed, death ensued in a few days.

Autopsy.—On slitting open the abscess at the back of the ear, the bone above and posterior to the meatus externus, over the space of a sixpence, was denuded, and was rough, black, and soft: the external table had been removed. On making a vertical section of the bone through the horizontal portion of the cells, the walls of the latter were observed in a state of disease, and the cavity contained purulent matter. The outer wall of this portion of the cells was carious throughout. The membranous meatus was softer than natural. The membrana tym-



A VERTICAL SECTION OF THE DISEASED BONE. THE WALLS OF THE HORIZONTAL MASTOID CAVITY ARE DISEASED; THE UPPER WALL FORMING PART OF THE CEREBRAL CAVITY, AND CONTINUOUS WITH THE EXTERNAL WALL, IS CARIOUS; THE ENTIRE SUBSTANCE OF THE EXTERNAL WALL IS DEAD.

pani had been entirely removed by ulceration, as also parts of the tympanic mucous membrane; the small portions remaining being thick, soft, and of a livid colour. The long process of the malleus had disappeared, and the remnant was partially disconnected from the incus, as was the incus from the stapes. The inner surface of the carious bone is of a dark colour, and is itself carious, presenting numerous small depressions. The thick, soft, and red dura mater was separated from the carious bone by a transparent fluid. On examining the *right ear*, the same disease appeared, but in an incipient state; the meatus was soft and red; the membrana tympani thick, white, and concave; the mucous membrane lining the tympanum and mastoid cells was thick and red; and there was a collection of mucus. Another

case which occurred under the care of Mr. H. J. Johnson, when assistant-surgeon to St. George's Hospital, is as nearly as possible a counterpart of the one just cited; and the specimen for which I am indebted to that gentleman, is almost a fac-simile of the preceding one.

Disease sometimes extends upwards and outwards, and destroys nearly the whole of the squamous portion. A case of this kind was brought under my notice by Mr. Willing of Hampstead. The following are the particulars furnished by him.

Case III. *Scrofulous disease in the horizontal portion of the mastoid cells before the first year; destruction of a large part of the squamous bone by caries; disease of the dura mater; a small abscess in the cerebrum.*—M. A. W., aged 11 months, the youngest of three children; the other two were healthy. The parents are in bad circumstances; the mother very emaciated, having during her pregnancy had very insufficient food, owing to her husband, a bricklayer's labourer, being out of work for a long time. The child was first seen by Mr. Willing in June, 1850, and was then three months old, small and much atrophied. The mother said it was small when born; and as she had no milk, she endeavoured to bring it up by hand. There had been, she added, a discharge from the right ear since birth. On examination, a redness and tumefaction both of the meatus and ear were observed, with evident tenderness on pressure of the mastoid process, and the cervical glands were enlarged. The child suffered under diarrhœa, and was extremely weak. Cod-liver oil was administered, and emollients applied to the ear, which was syringed daily with warm water. Under this treatment the child somewhat improved until October, when paralysis occurred on the left side of the face. The discharge grew more abundant, the soft parts round the ear became sloughy, and the mastoid process offered no resistance to pressure. These symptoms lasted till the death of the child in February.

Autopsy, thirty-two hours after death.—The body was so much emaciated as to be scarcely larger than at birth. The dura mater was very thin, and the surface of the brain greatly congested, with patches of dark-coloured blood scattered over its hemispheres, especially on the right side, where, in one or two places, they extended to the depth of three or four lines

into the substance of the brain. The cerebral veins were distended by coagula. At the surface of the posterior part of the middle lobe, on the right side, was a small abscess, the size of a pea. The ventricles contained about three ounces of thick, turbid serum. The middle cerebral arteries were distended by firm fibrin, and there were about four ounces of fluid at the base of the brain. The dura mater covering the petrous portion of the right temporal bone was separated from it by pus, and very much thickened.

On examining the temporal bone, which Mr. Willing presented to me, I found that the part of the squamous portion between the root of the zygomatic process and the mastoid process had been entirely destroyed; and that the larger part of the mastoid process had also disappeared, causing an aperture an inch in length, and three-quarters of an inch in depth. The petrous bone was detached, and both its superior and posterior surfaces were carious. The small remaining portion of the mastoid cells contained scrofulous matter.

In other cases the disease may advance to a very considerable extent, and then, supposing the health to improve, reparative efforts may be made. A highly interesting case of this kind was brought under my notice through the kindness of Mr. French, to whom I am indebted for the opportunity of making a careful dissection of the ear. The case derives additional interest from the fact that it was the subject of judicial proceedings, the exciting cause of the fatal symptoms being a blow on the head.

Case IV. *Catarrh of the mucous membrane of the horizontal portion of the mastoid cells in childhood; caries of the bone; partial reparation by deposit of new bone. Death following a blow on the head; abscess in cerebrum.*—E. C., aged 12, previously in good health, was seen on the 3rd of July, 1850, on account of violent pain in the head, chiefly in the left temporal region, accompanied by severe febrile symptoms. The day before she had received a violent blow on the head, during a scuffle; she was thrown down, her head struck against the door, and subsequently against the wall: a similar, but less severe assault, was repeated a few minutes afterwards. On *examination*, there was a fulness of outline, and a puffiness of the temporal muscle. The symptoms of cerebral irritation and fever rapidly increased; a large abscess

formed beneath the temporal muscle; discharge issued from the ear; coma ensued; and death occurred twenty-two days after the injury. It could not be ascertained whether there was a history of discharge from the ear in earlier childhood.

Autopsy.—The pericranium was found separated from the squamous bone by purulent matter; the dura mater lining the squamous bone, and covering the upper wall of the tympanum, was thicker than natural, and but slightly adherent to the bone; the arachnoid and a portion of cerebral matter were attached to this part of the dura mater. In the cavity of the middle cerebral lobe was an abscess containing four ounces of pus. The petrous bone was diseased. The membranous meatus was thicker than natural, and its free surface was smooth, presenting no signs of ulceration. The superior and posterior walls of the osseous meatus were rough, and this roughness was produced by a deposit of new bone, which was also found to extend on the outer surface of the squamous bone, above the meatus, for a space measuring half an inch in its vertical, and an inch in its antero-posterior diameter. The posterior two-thirds of the membrana tympani were absent; the mucous membrane of the tympanum was healthy; but in the passage to the mastoid cells there was a collection of pus and scrofulous matter, which had not been freely discharged on account of the small size of the aperture leading into the tympanum, contracted as it was by the thick mucous membrane. The upper wall of the tympanum was in a diseased state; the surface next to the dura mater being composed of a very fine scale of dead bone, about six inches long by four broad, which was perforated by small orifices, and eaten away posteriorly in parts. Beneath this dead bone was a layer of new bone, which formed the upper wall of the tympanum, and was continued upwards and outwards on the inner surface of the squamous bone to its upper margin. The old bone underneath and adjacent to the new bone was worm-eaten, and had been the seat of the disease; it was about half an inch in breadth.

There can be no doubt, from the examination of the specimen, that disease in the horizontal portion of the mastoid cells had commenced in early childhood; that, as in the cases previously cited, the squamous bone became diseased, the dura mater and the cerebrum being also affected, but not to such a

degree as to endanger life. It would further appear, that as the bone was developed, new bone was deposited on each side of the diseased squamous bone, and extended into the meatus, which, it will be remembered, forms in the first few years of life part of the squamous bone; and it is possible that, in spite of the disease of the brain and dura mater, the patient might have lived many years, if no very active exciting cause had been brought into operation. At the same time, it is most probable that the blow on the head would not have caused death had there not been pre-existing disease; and in this view the Grand Jury concurred.

The peculiar anatomical relations of the mastoid cells in childhood have now been pointed out: it has been shown, that in the first year of life the mastoid process is not developed, and consists merely of the horizontal portion, which is intimately connected with the cerebral cavity, to which, in childhood, disease is usually propagated rather than to the cavity of the cerebellum. Those cases of disease in early life which have been hitherto described, must be, therefore, considered as exceptions to the rule previously laid down by me,—that affections of the mastoid cells produce disease in the cerebellum.

(*b.*) DISEASES OF THE MASTOID CELLS IN THE ADULT.

Subsequent to the second or third year of life, when the mastoid process is somewhat developed, it will be found that the layer of bone bounding the horizontal portion externally, attains to a thickness of three or four lines, and becomes extremely dense. Hence, after the first or second year of life, disease is scarcely ever observed to extend from the horizontal portion to the outer surface of the squamous bone; but as the cells are developed posteriorly, and contract intimate relations with the lateral sinus and the cerebellum, it is to these two parts that disease is communicated.

Cases of disease in the mastoid cells may be divided into *acute* and *chronic*.

I. *Acute inflammation of the mucous membrane lining the mastoid cells.*—This affection is somewhat rare, and when it does occur, is usually subdued before it progresses to the bone or dura mater.

Cases, however, are occasionally met with in which acute

inflammation of the mucous membrane lining the mastoid cells ends in suppuration, the lateral sinus becomes inflamed, and abscesses occur in the brain. The following is a case of the kind which occurred to Dr. Brinton, at the Royal Free Hospital, to whom I am indebted for the notes of the case, and for the opportunity of making the dissection.

Case I. *Acute inflammation of the mucous membrane lining the mastoid cells; suppuration; disease of the lateral sinus; abscess in the cerebellum.*—A girl, aged 21, was admitted into the hospital, three weeks subsequent to an attack of scarlet fever. The history was, that since the fever, she has had a constant and abundant discharge from the left ear. On admission, this discharge was observed to be copious; she was drowsy, and at times almost comatose, with a rapid feeble pulse, a cold body and limbs, and a hot face and head. In spite of all the remedies employed, the coma gradually grew more intense, and she died ten days after her admission.

Autopsy.—An abscess was found in the left lobe of the cerebellum, of the size of a walnut. It extended to the surface, and thus came in contact with a large quantity of pus, bounded by the diseased and distended walls of the lateral sinus, which latter contained pus and blood. There was an opening through the membrana tympani of a regular shape, and of a size one-third the whole diameter of the membrane. The upper wall of the tympanum was healthy, and not even discoloured. The portion of the mastoid cells posterior to the incus contained some pus and blood mixed together; this extended down as far as the mastoid process. The portion of the lateral sulcus, about an inch long by half an inch broad, which forms the exterior boundary of this part of the mastoid cells, was of a dark leaden colour. The canals in this portion of the bone were also distended with black matter.

It seems to me, there can be no doubt that, in this case, the purulent matter from the mastoid cells was the cause of the disease in the lateral sinus, for the blood-vessels between the two parts were distended with dark pus and blood.

II. *Chronic inflammation of the mucous membrane lining the mastoid cells.*—Cases of chronic disease of the mastoid cells usually take their origin before the adult period of life, although the more serious symptoms may not be developed until after that period.

As in disease of the tympanum, the cases now under consideration commonly originate in chronic inflammation of the mucous membrane. Whatever may be the cause of this inflammation,—whether scarlet fever, measles, or an ordinary cold,—the result is the secretion of a larger quantity of mucus than is natural, which in the milder forms of the affection is afterwards absorbed, or else discharged through the tympanic cavity and Eustachian tube, into the cavity of the fauces; but in the more severe, to which attention has now to be directed, the mucous secretion is too abundant to escape from the cells, and the bone becomes affected.

The effects of chronic disease in the mastoid cells upon the lateral sinus and cerebellum are :—

1st. Suppuration in the lateral sinus with or without secondary purulent deposits.

2nd. Inflammation of the dura mater and arachnoid, and the formation of pus on the surface of the cerebellum.

3rd. Abscess in the cerebellum.

The history of cases of chronic disease in the mastoid cells bears some analogy to that of those occurring in the tympanic cavity, although, as a general rule, there is more irritation from the outset of the affection, and consequently attention is attracted to the case in its early stages; and this is the reason, as will be seen when the treatment is spoken of, why the disease is more amenable to remedial measures than when it attacks the tympanum. The following may be taken as the ordinary history of a case of disease advancing from the mastoid process to the lateral sinus or cerebellum. The patient, who has often a tendency to glandular enlargements, has suffered when a child from pain in the ear, followed by discharge. During childhood, and perhaps up to adult age, there have occurred attacks of pain and discharge at intervals of some months. Between the attacks there is often a sensation of pain in the region of the mastoid process and back of the head, and giddiness sometimes comes on. These symptoms are aggravated by fatigue or any other depressing influence. Upon examination, the surface of the meatus is seen to be red, and to be the source of the discharge. No perforation exists in the membrana tympani, which, however, is white and thickened, so that the discharge is purely sympathetic. The surgeon is more commonly called, however, to

cases where the symptoms have become much more urgent, and where, indeed, the disease has advanced so far that the brain or its membranes have become so greatly disorganised as to defy all remedial measures.

Cases of disease in the mastoid cells terminate fatally from two different causes.

1st. From purulent infection, arising from the introduction of pus into the circulation through the lateral sinus.

2nd. From disease of the cerebellum or its membranes.

Cases of purulent infection have not been met with when the disease occurs in the tympanic cavity. On account of the proximity of the jugular vein to the lower wall of the tympanum, it is, however, quite possible for disease to extend to the venous system.

Dr. Abercrombie published an interesting case of purulent infection from disease of the ear; but the subject has been more thoroughly investigated by Dr. Watson, who, although deprived of the opportunity of making *post-mortem* inspections of the highly important cases he has so fully described, had no doubt in his mind, and leaves no doubt in the minds of his readers, that the cause of death was the introduction of pus into the system from the mastoid cells. Dr. Bruce has since published some valuable cases bearing upon the subject; Mr. Wilde gives the details of a case in his work on the ear; and more recently still, Dr. Gull, in the Guy's Hospital Reports, has thrown much light on the subject. The facts brought forward by these gentlemen, coupled with those which are now to be related as the result of my own experience, will, I trust, lead to a thorough comprehension of the nature and progress of the disease. Dr. Abercrombie's case is the following :—

Disease of the mastoid cells; deposit in the lateral sinus; secondary deposit in the pleura.—A young lady, aged 15, had been liable for six or seven years to attacks of pain in the right ear, followed by discharge of matter; but she had been free from any of these attacks for some time previous to the abscess which forms the subject of the following history. On the 25th April, 1822, she complained of cold shivering through the day, and in the evening had headache with pain in the right ear, symptoms which continued on the following day. On the 28th she was seen by Mr.

Brown, who found her with quick pulse and foul tongue, severe pain in the ear, and slight headache. On the 29th some discharge took place from the ear, but without relieving the pain which continued with violence until the next day. On the 1st of May the pain had somewhat abated in the ear, but had extended over the right side of the head; pulse frequent. General and local blood-letting were employed with partial relief. I saw her on the 3rd; the headache was then rather abated; the pulse was frequent and weak; she had a pale, unhealthy aspect, and a look of oppression bordering upon coma. The pain was chiefly referred to the parts above and behind the right ear, where the integuments were painful on pressure, and, at one spot near the mastoid process, felt soft and elevated. A puncture was made at this place with a lancet, but nothing was discharged. Topical bleeding, blistering, &c., were recommended.

4th.—Pulse in the morning 148; in the course of the day it fell to 84; looking very languid and exhausted.

5th.—Dark-coloured matter of intolerable fetor began to be discharged from the puncture which had been made behind the ear. The opening here was enlarged, and a probe being introduced, the bone was felt bare and rough over a considerable space; headache much relieved; pulse natural.

6th.—Great discharge from the opening, headache much relieved; pulse 112; complained of some pain in the left side of the thorax, and there was considerable diarrhœa.

7th.—No headache; there was much discharge of fetid matter from the opening near the mastoid process, and a probe introduced by it passed downwards and backwards, under the integuments, as far as the spine.

8th.—Pain in the thorax continued, and was now so urgent that a small bleeding was employed with partial relief; it could not be carried further on account of increasing weakness; pulse 140.

9th.—Said she felt better, and made no complaint of pain; pulse very rapid, and strength sinking.

Died on the 10th.

Autopsy.—Every part of the brain was in the most healthy state, except a small portion on the right side, near the ear, which was of a dark leaden colour; the tinge, however, was

entirely superficial. The right temporal bone externally was bare, through a great part of its extent; internally, it was in many places rough and dark coloured; and there was some dark-coloured matter betwixt it and the dura mater. The dura mater at this place was, for a considerable space, thickened, spongy and irregular; the coats of the right lateral sinus were greatly thickened through its whole extent, and the capacity of the sinus was very much diminished by a deposition similar to that which occurs in the cavity of an aneurism. The internal ear contained dark-coloured matter; the left cavity of the pleura contained fully a pound of puriform fluid; the left lung was collapsed, dense, dark coloured, and covered by a coating of coagulable lymph.

From the examination made by me of deposits in the cavity of the lateral sinus, I have no doubt that the matter alluded to in the above case, consisted of coagulated blood mixed with pus.

The following is one of Dr. Watson's cases:—"A boy, 11 years old, had had a discharge of offensive, purulent matter from his ear since the time when, four years before, he had gone through an attack of scarlet fever. In August, 1833, he went for a walk into Kensington Gardens, and there lay down and slept upon the damp grass. The next day he was attacked with headache, shivering and fever; strong rigors, followed by heat and perspiration, occurred very regularly for two or three days in succession, suggesting the suspicion that his complaint might be ague; but then pain and swelling of some of the joints came on, and were at first considered rheumatic. However, the true and alarming nature of the complaint soon became apparent; abscesses formed in and about the affected joints, and one of these fluctuating swellings was opened, and a considerable quantity of foul, grumous, dark-coloured matter let out. After about a fortnight, the child sank under the continued irritation of the disease. The hip-joint presented a frightful specimen of disorganization; it was full of unhealthy sanious pus; the ligamentum teres was destroyed, the articular cartilages were gone; and matter had burrowed extensively among the surrounding muscles. The knee and ankle-joints of the same limb were in a similar condition. Unfortunately the head was not examined, but that the fatal disorder had penetrated from the

ear to the dura mater, I entertain no doubt: in all probability the inflammation had involved the veins or sinuses of the head."

Having given another case of a similar nature, Dr. Watson says:—

"I much lament that, in these instances, the direct link of connexion between the disease of the ear and the disorganization of the joints was not demonstrated, for seeing (they say) is believing. Yet the pain of the ear, the discharge of pus from the external meatus, the subsequent pain in the head, coming on with fever and rigors, and followed, after a short interval, by destructive suppuration in several distant parts, and, in the latter case, the actual femoral phlebitis,—these circumstances form a chain of presumptive evidence amounting, in my judgment, to moral certainty, that the fatal mischief, in each case, found entrance through the porches of the ear, and that the dura mater underwent inflammation. The same evidence is scarcely less affirmative of the complication of cerebral phlebitis. Perhaps the veins of the diploë, which, in the cranial bones, are of considerable magnitude, were involved in the inflammatory mischief; perhaps the large sinuses of the brain. The close proximity of the lateral sinus to the diseased bone, and its formation by a duplicature of the dura mater, would seem to render such a complication highly probable."

The direct link of connexion between the disease in the ear and that of the circulating system was pointed out by Dr. Bruce, and also in the case cited by Mr. Wilde. In the latter, "The membranous walls of the right lateral sinus, throughout the whole of the mastoid portion of its course, were much thickened, and their lining presented a sloughy appearance, being covered with lymph of a greenish hue, and smeared with unhealthy purulent matter. This condition of the lining membrane extended along the jugular vein and superior vena cava to within a short distance of the entrance of the latter into the auricle. The left cavity of the pleura contained about four ounces of a thin fetid matter." In addition to the facts above cited, all that is required is, an account of the exact condition of the ear; and this has been supplied by me in the following case, which occurred to Dr. Heale, at the Free Hospital.

Case II. *Pus in mastoid cells; caries of the lateral sulcus; pus in the lateral sinus; secondary deposits.*—Harriet G., aged 20,

was admitted into the hospital on the 9th March, 1850. She had great fluttering and irregular vibrating action of the heart, resembling erythismus mercurialis, but which subsided in a day or two. She was deaf in the left ear, and had long been subject to intense ear-ache, with occasional fetid discharge from the meatus. She was restless, sleepless, occasionally delirious, and had no appetite. Soon after her admission, an abscess formed just above the left collar-bone, which discharged large quantities of matter until her decease. The disturbance of the heart's action returned after three doses of hyd. c. cretâ, six grains having been given every six hours; but it again subsided in about two days. She then had severe delirium, which abated after a sudden large and fetid discharge from the left ear: finally she had erysipelas, violent delirium, succeeded by coma, and died on the 15th of April.

Autopsy.—A very large excavated abscess, with sinuses in various directions, was exposed at the root of the neck on the left side, communicating with and extending through the whole of the carotid sheath. The internal jugular vein was full of matter, which was also found burrowing down in the direction of the vena innominata; a fibrinous clot was found in that vein extending into the descending vena cava; and having been examined by the microscope, was found to contain pus globules. The lungs were filled with a frothy and purulent infiltration, without consolidation, and there was a small circumscribed abscess between the pleura pulmonalis and the right lung, which, however, did not extend into the substance of the latter. The heart was healthy; the liver pale-coloured. The cerebrum was healthy; the arachnoid membrane, in parts, appeared smeared over with pus, more particularly in the posterior part, near the falx, joining the tentorium. The tentorium covering the left lobe of the cerebellum was much inflamed, thickened, and had matter between it and the arachnoid covering that lobe of the cerebellum; and immediately beneath this, on cutting into the cerebellum, a circumscribed abscess, about the size of a walnut, was discovered. This was nearer to the falx cerebelli than to the outer margin of the cerebellum: the part of the cerebellum in contact with the cranial bones was healthy.

The petrous bone was examined by myself, and reported upon, as follows:—

The meatus externus contained purulent matter. The glandular and periosteal portions of the membranous meatus were much softer than natural, and adhered but slightly to the surface of the bone. The bone forming the upper and outer half of the tube was found to present numerous foramina for the transmission of blood-vessels, which were much larger than natural, and some of them surrounded by delicate layers of new bone: through the larger of these foramina good-sized bristles could be passed, and they appeared to communicate with canals in the interior of the bone, which were themselves continuous with orifices in the sulcus lateralis at its inner surface. The lateral sinus was of a dark brown colour, and the dura mater forming its exterior wall was entire. The sinus was full of coagulated blood, mixed with purulent matter. The dura mater constituting its anterior wall, and which was in contact with the surface of the bone forming the sulcus lateralis, was very thick and soft; portions of it were destroyed by ulceration, and the bone was exposed. This bone was dark in colour, and covered by masses of lymph and pus; its surface was rough, presenting throughout numerous orifices and tortuous grooves,—an appearance which was produced by the nearly complete absence of the internal table of the skull, that (with the exception of two scales, each measuring about two lines in diameter) having been destroyed by caries.

A carious orifice existed between the cavity of the cerebellum and the mastoid cells. The bone forming the jugular fossa was also carious. There was an orifice in the posterior part of the membrana tympani.

The tympanic mucous membrane was much thicker than natural, and in the upper osseous wall were observed a few small foramina for blood-vessels, and a carious orifice of a size sufficient to allow the passage of a small pin.

The mastoid cells at their upper part formed a cavity about the size of an ordinary horse-bean, and contained pus. This cavity communicated posteriorly with the lateral sulcus by means of an orifice three lines in diameter. Anteriorly, the orifice into the tympanic cavity was not more than two lines in diameter, and was placed above the level of the floor of the cavity containing the pus.

It has been already stated that the anterior wall of the mas-

toid cells is formed by the posterior wall of the osseous external meatus. The latter wall, in some cases, becomes carious, and matter is discharged through it, as was the case in the following interesting instance, but the orifice was not large enough to be effectual in relieving the symptoms.

Case III. *Pus and scrofulous matter in the mastoid cells; communication with the lateral sinus by the veins; secondary deposit in pleura.*—Kitty D., aged 15, was admitted under my care as an out-patient of St. Mary's Hospital on the 16th of February, 1854. She stated that six months previously she suffered from pain in the left ear, which was followed by dulness of hearing in it, as well as in the right ear, which had remained to the present time, accompanied by a discharge from the left ear. On examining the left ear, a small red polypus was seen at the inferior part of the meatus, near to the membrana tympani: the latter membrane was white. She did not complain of pain in the head. Gentle counter-irritation was ordered behind the ear, which was to be syringed with a weak astringent lotion. The patient continued much the same until March 27th, when she was admitted, in my absence, as an urgent case, under Dr. Sibson, into the hospital. When admitted, she was partially unconscious, extremely prostrate, and could not speak: the skin was parched; the tongue brown and dry; pulse 140, very small and thready; pupils sluggish—the left rather more contracted than the right. On inquiry, it was found that, three days before, a marked difference was perceived in her manner, and attributed to the pain in the head and left ear, of which she complained greatly. She was unable to do any work. On the 25th, she kept her bed; on the 26th, she became still worse; and on the 27th, application was made at the hospital. Upon being seen by one of the officers, she was at once admitted. Stimulants were freely administered, and the patient somewhat rallied: during the night, she was very restless, and wandered a good deal.

28th.—Seems quite sensible of all that is done to her, but does not speak, muttering only to herself. Pulse 140; skin hot, though some moisture is still apparent. Loud sonorous rhonchus of right lung; the head is held to the right side, the mouth also is drawn to the right; the nostrils are expanded; and there is partial paralysis of some of the muscles on the left side of the

face. She was supported by stimulants at the same time that a leech was applied to the neck. 10 P.M.—Very low, surface cold; skin clammy; face livid; subsultus tendinum; pulse feeble and irregular.

29th.—Much as yesterday; rambled during the night; voids urine involuntarily; tongue brown and moist; pulse 140, very small. During the evening very low; voided urine in the bed; muscles suddenly contracting.

30th.—Slept badly; at times wandered much; breathing hurried; pulse 140; nostrils dilated. She gradually became worse, and died at 2.15 P.M.

Autopsy.—Cerebrum firm; ventricles dry; grey substance very dark. Over the left lobe of the cerebellum, at the posterior part of the petrous bone, is a dark bluish portion, of the size of half-a-crown. The grey matter of the cerebellum very blue to the depth of one-eighth of an inch, and beneath the discoloured spot the substance of the cerebellum was slightly softened. There were considerable adhesions between the lungs and the pleura costalis; and also tubercular deposit covered by an unhealthy plastic, fibrinous exudation; the pleural cavities contained a pint of fluid. The dura mater forming the posterior wall of the lateral sinus (where it is situated in the temporal bone) was of a dark colour and soft; the sinus contained, at its upper part, a firm coagulum of dark-coloured fibrin; at its lower part it was full of dark-coloured pus. The anterior wall of the sinus was attached to the bone much less firmly than natural. The mastoid cells were full of pus and scrofulous matter; and their anterior wall presented an orifice, about two lines in diameter, which opened into the meatus externus. The incus and the thick mucous membrane around it prevented the pus from escaping. The orifices for the passage of the blood-vessels from the mastoid cells to the lateral sinus were somewhat larger than natural.

It will be observed that in this case there was no caries of the bone towards the cerebellum; and the only means by which the disease from the mastoid cells could be propagated to the cavity of the lateral sinus, must have been the veins.

A sufficient number of facts have now been cited to show how very insidiously disease progresses from the mastoid cells to the cerebellum and lateral sinus, and to prove that the sinus may

become influenced, purulent matter developed within it, and secondary abscesses produced, without the occurrence of caries in the bone forming the sinus lateralis.

It has been already stated that the cause of disease advancing from the mastoid cells to the lateral sinus and the brain, is the retention of the discharge within these cells, instead of its finding a free egress through the external meatus.

In the cases of death from purulent infection which have been detailed, it will have been observed that there was merely a small aperture in the membrana tympani, so that only part of the matter could be discharged from the mastoid cells; and it seems to me probable, that if, in any way, a sufficient portion of the membrana tympani had been removed at the beginning of the attack, to permit of a thorough evacuation of the contents of the mastoid cells, the bone would have remained free from disease—an opinion which seems corroborated by the following case: for it will be noted that the scarlet fever appears to have attacked the mastoid cells of each ear equally. In each, the lower half of the membrana tympani was destroyed; but in the organ of which the bone became diseased, it will be remarked that the lower margin of the remnant of the membrana tympani fell inwards towards the promontory, to which it became attached, and by this means the escape of matter from the mastoid cells was prevented; while, in the other ear, the lower margin of the membrane remained free, and the discharge readily escaped. The case, of which the particulars were sent to me by a friend, together with the petrous bones, is of importance on other grounds, since it shows the coexistence of disease in the mastoidal and tympanic cavities, and the cotemporaneous production of disease in the cerebrum and cerebellum. It is further of interest as pointing out how very little relation exists between the condition of the bone forming the lateral sulcus, and the contents of the lateral sinus. In some cases already described, the lateral sinus contained a large quantity of pus, but the bone was not carious; whereas in the following case, where the bone forming the lateral sulcus was so much diseased that a large portion was necrosed and completely detached from the surrounding parts, there was no pus in the sinus. The explanation of this circumstance, found also in other cases, is most probably to be sought for in the fact, that when there is

extensive caries of the substance of the bone, there is more space for the matter, and hence the pressure upon the sinus is comparatively slight.

Case IV. *Catarrhal inflammation of the mucous membrane lining the mastoid cells of the ear; retention of the discharge in the right ear by the adhesion of the membrana tympani to the promontory; caries of the right lateral sulcus, and abscesses in the cerebrum and cerebellum.*—J. R., aged 12, had an attack of scarlet fever two years previously, since which he has had a discharge of matter from each ear, and a considerable diminution of the hearing power. On the 13th of February, 1854, he complained of rigors and general *malaise;* these were followed by febrile symptoms and pain behind the left ear. On the 15th, a small abscess was observed behind the ear, which, when opened, discharged a sanguineous fluid. There was a slight degree of stupor, and the discharge continued without relief to the pain. On the 20th he had somewhat improved; pain less; stupor diminished; discharge from the meatus as well as from the abscess. On the 21st, another abscess formed over the mastoid process; pulse small and frequent, discharge very fetid. 22nd.—Decidedly improved in every respect; but the pain and feverish symptoms returned on the 23rd in an aggravated form; the drowsiness much increased, so that he had to be roused up to take his food, and he soon fell back again into the same state. He gradually became weaker; the urine and fæces were passed involuntarily; the stupor was increased; and the prostration was extreme. On the 4th of March, he had two severe rigors, and constantly cried out on account of the severe pain in the head. The pain gradually increased till the 6th of March, when attacks of pain came on every ten minutes, and of so acute a character as to cause him to scream. During the succeeding seven days he suffered much less pain; and there was a copious sanious discharge from the ear and from the abscess. On the 15th, the stomach became irritable, and rejected everything introduced into it. The pain, at times, was extreme. On the 16th, at twenty minutes past twelve, he suddenly became convulsed, the face and chest were of a deep blue, the pulse was imperceptible at the wrist, the pupils dilated and fixed, and in this state he died. Upon inquiry, it appeared that, since the

fever, the patient had suffered from frequent headaches, languor and drowsiness.

Autopsy.—The blood-vessels of the dura mater were highly congested. In the sulcus lateralis was a portion of necrosed bone, about three quarters of an inch long, and half an inch broad, and quite detached from the surrounding bone: its outer part formed a portion of the mastoid process; between this detached piece of bone and the dura mater was a large quantity of purulent matter, which communicated with the superficial abscess behind the ear. An abscess was also found in the substance of the middle lobe of the cerebrum. Upon examining the ear, the lower half of the membrana tympani was found to have been destroyed, and the inferior half of the upper part was attached to the promontory, so that the upper portion of the cavity of the tympanum was closed, and the matter secreted there had no exit. The tympanic mucous membrane was thick, and ulcerated in parts, and the mastoid cells presented a large cavity full of pus. In the opposite ear the lower two-thirds of the membrana tympani were absent, but the upper part was not adherent to the promontory; so that there was ample room for the egress of discharge from the tympanum. The tympanic mucous membrane was thick, but not otherwise diseased; the bone was healthy.

A case very similar to the last cited was brought under my notice by Dr. Ogle, who was so good as to give me the preparation. In this case the disease had made way externally, so that the mastoid process was broken up, while the sulcus lateralis was by comparison but slightly affected. The veins seem to have been the medium of communication with the lateral sinus, and the cause of the deposit of pus within it. The question would probably be asked, why, in these cases of disease in the mastoid cells, does not the matter make its way outwards through the external wall of the mastoid process? It will be observed, that this outward advance of the disease has already been noticed in three of the cases; but while this was going on, the internal wall of the mastoid cells, or of the lateral sinus, became so diseased as to destroy life. It must also be borne in mind that cases are of very frequent occurrence where the disease advances externally, destroying part of the mastoid process, which often

comes away *en masse*, and where the brain and its membranes suffer but slightly. Cases of this kind generally originate in an attack of scarlet fever, or of cold; sometimes the symptoms of cerebral irritation are but slight, at others, very severe, and usually subside when there is a free discharge externally, as will be seen when speaking of the treatment.

In the course of the previous observations, it has been stated that in cases of disease within the tympanic cavity catarrh of the dermoid meatus takes place, as the result of sympathetic action, and without the existence of any orifice in the membrana tympani. It is important to bear this fact in mind, because the attention of the surgeon is apt to be drawn from the real disease towards the affection of the meatus; indeed, in many cases of irritation of the external meatus, arising from obstruction of the Eustachian tube, the primary disease is often overlooked, and the cause of deafness supposed to reside in the irritation of the meatus. The meatus externus not only sympathises with the condition of the tympanic cavity, by becoming the seat of catarrh, but not unfrequently polypi are developed within it. When this happens in cases where there are symptoms of disease of the bone, great care must be taken not to increase the irritation of the ear by interfering with the polypus. The following case is, in this view, worthy of the most attentive consideration. It was laid before the Pathological Society in 1851, by the late Mr. Avery, and reported upon by myself.

Case V. *Caries of the mastoid cells; polypi in the external meatus; abscess in the cerebellum.*—A man, aged 35, had suffered for some years from frequent ear-ache of a severe character, accompanied by discharge. About five weeks before his death a large polypus was removed from the external meatus. This was followed soon after by great pain at the back of the head, in the right side, and down the neck and shoulder, of a plunging intermitting character.

These pains were treated at first as neuralgic; but they increased in severity and frequency, and rest could only be obtained by the oft-repeated doses of laudanum. The patient appeared generally to be dull, heavy, stupid, and incapable of making any exertion. He several times remarked that people must have thought him intoxicated when in the street, as his gait was so very unsteady that he was often obliged to lay hold of the rails

to prevent himself from falling. He ultimately became comatose, and died.

Autopsy.—The brain was found to fill the cranial cavity, and the convolutions were very closely pressed together. The arachnoid membrane was extraordinarily dry; the lateral ventricles contained a very large quantity of clear limpid fluid, and the fornix and septum lucidum were very white and soft. On separating the cerebellum from the petrous portion of the temporal bone, a gush of thick creamy pus took place, and an abscess was found occupying a cavity in the right lobe, large enough to hold a pigeon's egg. The contents of this cavity were very fetid, and the walls were firm and lined by false membrane, being thin at the point where the cerebellum rested on the aquæductus vestibuli of the temporal bone. At this spot there was a small ulcerated opening in the dura mater, communicating with a carious portion of temporal bone, and it was here that the disease had been continued to the cerebellum. There was no loose lymph in the cavity of the arachnoid, and only a thin film covering it near the ulcerated opening in the dura mater. The unsteadiness of his gait, in connexion with the abscess in the cerebellum, was very remarkable; but it could not be ascertained, on repeated inquiry, that the want of power over the regulation of his movements affected one side of the body more than the other.

Upon examining the petrous bone, two small polypi were found attached to the upper and posterior part of the membrana tympani, which was very thick, and presented a small orifice at its anterior part. The membranous meatus was easily detached from the bone, which was darker and rougher than natural. The mastoid cells were carious and full of pus. On removing the dura mater from the posterior surface of the petrous bone, the upper part of the sulcus lateralis was found to be carious for a space three lines in diameter, and the orifices in the bone were filled with fibrin. The dura mater covering the sulcus lateralis was softened, but the disease had not penetrated to the cavity of the sinus. The dura mater adjacent to the fossa jugularis was soft and partially destroyed by ulceration. The bone beneath it was carious, and was found to form part of the posterior wall of the inner extremity of the mastoid cells, from which the disease had been propagated.

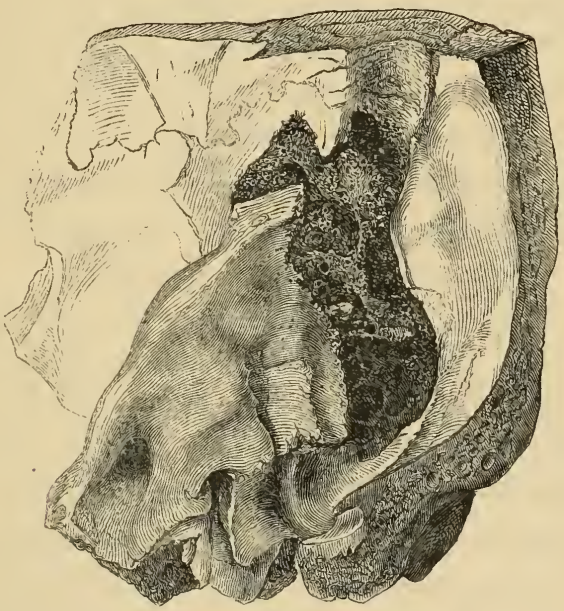
In addition to the other points of interest in this case, is the fact that disease may be propagated to the jugular vein from the mastoid cells, without the intervention of the lateral sinus.

I believe it to be rare for disease in the mastoid cells to manifest itself for the first time after the adult period. The following is an instance of the kind. It is impossible to say how long there had been incipient disease; but from the appearances after death, it is probable that it was of long standing. The case is of great interest, from the fact of the existence of so large an amount of disease, and the presence of formidable symptoms for so short a time only before death.

Case VI. *Caries of the mastoid cells; destruction of the sulcus lateralis; pus discharged behind the ear.*—T. D., aged 29, was under the care of a friend, in May, 1851, on account of diabetes. He remained under treatment for ten weeks, during which time he did not complain of pain either in the head or ear. At the expiration of the ten weeks he went into the country for a fortnight, and shortly after his return he began to speak of pain in the head, which was principally referred to the right mastoid process. This pain, accompanied by violent ear-ache, gradually increased, and was attended by a purulent discharge from the ear. Drowsiness, giddiness, and stupor supervened. These symptoms were not relieved by the most active treatment. Six weeks previous to his death, an abscess was opened behind the right ear, from which a large quantity of pus was discharged. No relief followed, the head symptoms gradually increasing until his death.

Autopsy.—The external meatus contained a large quantity of muco-purulent discharge; the surface of its dermoid layer was denuded of epidermis, and its substance much tumefied. The membrana tympani was entire, but of a dull leaden hue, and much softer than natural. The cavity of the tympanum contained a great quantity of purulent matter, and its lining membrane was vascular, thick, and flocculent. The incus had disappeared; the stapes was *in situ*, but was surrounded by bands of adhesion. The osseous walls of the tympanum were healthy. The mastoid cells were full of purulent matter, and the bony laminæ dividing the cells were extensively carious, large portions of them having been destroyed. The whole of the posterior wall of these cells, usually forming the sulcus late-

ralis, was completely destroyed, and in its place was an orifice measuring an inch and a quarter from above downwards, and more than half an inch in breadth. The orifice in reality corresponded exactly with the sulcus lateralis, as situated in the temporal bone, with the exception of half an inch before it reaches the fossa jugularis. A circular orifice, about the size of a pea, existed at the posterior part of the mastoid process, which com-



THE RIGHT PETROUS BONE, SHOWING THE CARIOUS CONDITION OF THE SULCUS LATERALIS.

municated with the aperture just mentioned, on the one hand, and with the abscess behind the ear, on the other. The membranous lateral sinus was much attenuated, and beneath it was a large quantity of pus. The state of the cerebellum was not reported.

From the paucity of the notes which accompanied the specimen, the cause of death was not quite clear; but most probably there was, in addition to the other symptoms, disease of the cerebellum. Probably the life of this patient might have been saved, if a free outlet for the discharge had been effected at an earlier period. It is important to notice to how great an extent the osseous sulcus lateralis was destroyed, without ulceration of the lateral sinus contained in it. In this respect the case is analogous to that of P. R.

A case of a similar character to the last was published by

Mr. Gray, of St. George's Hospital, in the *Transactions of the Pathological Society* for the Session 1848-49.

From previous remarks, it will have been gathered that the existence of long-continued discharge from the ear of the affected side, is one of the most frequent symptoms attendant upon caries of the mastoid portion of the bone. This discharge is usually accompanied by perforation of the membrana tympani, although, as has been pointed out, the discharge usually comes from the surface of the meatus, and is purely sympathetic. The case which follows is of interest, from the fact that the membrana tympani was entire, and yet there was slight discharge from the ear; and is further remarkable for the short duration of the chronic symptoms. It was published by Dr. Budd, of Bristol, in the year 1851, to whom I am indebted for the preparation, and for several additional particulars.

Case VII. *Catarrh of the mucous membrane lining the mastoid cells; membrana tympani entire; caries of the petrous bone; abscess in the cerebellum.*—"George Bell, aged 13, of spare habit and delicate appearance, but never before the subject of serious illness, was laid up, in the beginning of June, 1851, with an attack, which was at first considered to be one of simple fever. Two circumstances were, however, remarked, which the sequel showed to be of great importance. These were severe headaches, chiefly confined to the right temporal region, and a slight discharge from the right ear, with severe deafness on the same side.

"For the relief of these complaints, leeches were applied to the temple and behind the ear, followed by a blister to the same spot. Salines and a few gentle doses of mercury were given internally. Under this treatment the pain abated, the febrile symptoms entirely subsided, and in the course of a few days the boy was able to return to school, and resume his usual occupations. The pain in the temple, however, never entirely ceased. It was described as a dull pain, occasionally attended with throbbing. Up to this period there had been no vomiting, and no disorder in the motor or other powers of the nervous centres.

"On the 12th of June, he was again laid up, and on the following day, Mr. Tribe, his usual medical attendant, was sent for. The pain in the head had once more become continuous and

severe; and was limited still more strictly than before to the right temple, occupying, according to the patient's own description, a space not broader than a crown-piece. It was not either acute or lancinating. There was still great deafness in the right ear, though the discharge had ceased. An entirely new symptom of great significance was now added. Two days previously, the speech had become thick and indistinct, and was now at times almost unintelligible. Mental faculties unimpaired; memory accurate; no strabismus; no lateral or other deviation of the tongue; no sickness; pupils somewhat dilated, but equal and sensitive; vision good; no heat of surface; no thirst; extremities rather cold than otherwise; tongue moist but thickly coated; bowels torpid. Pulse about 100 in the minute, weak, and fluctuating. Complexion pale, and countenance deeply marked with the stamp of suffering.

"On the following day his gait was observed to be insecure, and there was a dragging of the right leg. The face was also drawn, but to which side was not noted. The pain in the head had extended itself across the forehead, and the patient had become drowsy. He had also vomited several times, rejecting everything as soon as taken, except milk, which sat well on the stomach. The bowels had been freely acted upon by an aperient, given the day before.

"Under these circumstances, it was decided to put the patient at once under the influence of mercury, and employ extensive counter-irritation. With this view, three grains of blue pill were given every four hours, and a blister was applied to the nape of the neck.

"On the following day, four grains of iodide of potassium were given with each dose of blue pill, and a blister was applied to the shaven scalp.

"On the 16th, the pain had extended to the back of the head, and there was at times double vision. The vomiting and drowsiness continued.

"On the 17th, that is to say, the fifth day after the relapse, marked amendment set in. The pain had much abated, being felt, in fact, only when the head was moved; the utterance had become more distinct, and the distortion of the features had disappeared; the drowsiness had ceased, and the vomiting had become much less frequent. There was still, however, some

slight thickness of speech, occasional double vision, and inequality of pulse.

"On the 19th he had so much recovered as to come down stairs; and on the 20th he dressed himself and descended without help. During the greater part of this day, he amused himself with his pencil; and several complicated heraldic drawings, executed with a firm and clear outline, which are still extant, show, better than any other evidence, how entirely the right arm had recovered its loss of power.

"Up to the 1st of July, the amendment had suffered no check; and on that day the patient was down stairs, running about, and quite cheerful. It is worth notice, that he occupied himself a good part of that day with a box of carpenter's tools, handling them with his usual freedom and effect.

"As the changes revealed by examination after death, coupled with the history already given, leave no doubt that at this time, one if not two abscesses of considerable size existed between the folds of the right lobe of the cerebellum, such an amount of recovery as this must be looked upon as a very remarkable circumstance; and as one which might readily lead an incautious practitioner to give a favourable prognosis. The only trace of cerebral disorder still remaining, was some slight thickness of speech.

"The hopes excited by this favourable change were, however, swept away on the following day, the 2nd of July, by a return of the former symptoms in still greater violence than before.

"On the 3rd of July I saw him for the first time, in consultation with Mr. Tribe, to whom I am chiefly indebted for the notes of the case.

"The condition of the patient was then very striking, and characteristic of severe intercranial mischief. The pain in the head, at all times severe, was occasionally so acute as to extort moans and cries. A very remarkable characteristic of the pain, was the intense degree to which it was aggravated by any, the slightest, movement of the head, voluntary or otherwise. The dread he showed at every such attempt, could not be readily forgotten by any one who witnessed it. The chief seat of the pain appeared to correspond with the base of the occipital bone on the right side; although, in less severity, it affected the whole head. His brow was deeply knit, and his whole aspect bore the

imprint of great suffering. He was very drowsy withal, so that his whole time was spent in dozing or acute pain. He yawned frequently; his pupils were much dilated, but equal and sensitive; and he was very intolerant of light. There was no discharge from the right ear, with which he could hear the ticking of a watch several inches off. Everything in the shape of food or medicine was vomited as soon as swallowed; the pulse varied, being at the time of my visit only forty strokes in the minute. The belly was deeply sunken and retracted; and the skin peculiarly dry and harsh. The grasp of the right hand seemed to be somewhat less firm than that of the left, but there was no impairment or loss of motor power (in the way of paralysis that is) in any other part. His mind was clear, and memory good; and his speech, though thick, was sufficiently intelligible. There had been no fit or convulsion from the first. The urine was scanty, and of high specific gravity, throwing down, on being boiled, a precipitate, which was immediately redissolved on the application of nitric acid. The tongue was coated with a thick yellow paste. From this time to the 7th of July there was little change, except that the vomiting became gradually less urgent. On that day, to the surprise of all, he began for the third time to amend; the pain in the head abated, the drowsiness lessened, and the sickness became less and less frequent. From this time he steadily improved, and on the 13th of July was so much better, that it was agreed I should suspend my visits for some days. The head was now almost free from pain, he moved with ease and freedom, and the vomiting had quite ceased. His utterance became much clearer; his tongue much cleaner; he began to take light nourishment with relish; and his bowels acted, for the first time, without medicine. Although there was no derangement amounting to paralysis, he had still a more perfect use of the left than of the right arm; feeding himself, for instance, by preference with the left hand.

"On the 14th the patient was put in a warm bath, which he much enjoyed; and, on being taken out, stood for some time leaning for support on his father's shoulder. This amendment was, however, of short duration.

"On the following day he became much worse, and, in the course of it, was several times seized with severe paroxysms of pain, lasting many minutes. During this time, the eyes were

fixed, and the pupils gradually dilated more and more, till the agony passed into unconsciousness; he then remained for some time in a state of deep stupor, from which he slowly recovered. Although there was no convulsion, each of these attacks was followed by great exhaustion.

"From this period he lingered, with very little change and no new phenomena, until the 17th of July, when he expired rather suddenly, after one of the paroxysms just described.

"The powers of the left hand and arm were unaffected throughout, with this single exception, that, for a short time on the 9th of July, the fingers were spasmodically bent on the hand. He helped himself to a cup of coffee without difficulty with that hand, about half an hour before his death.

"The principal agents employed in his treatment were bitters, and mercury both internally and by inunction. Latterly opiates were given to lull the pain, and alkalies for the sickness; but the latter with little or no effect.

"The body was examined twenty-six hours after death. On opening the head, the ventricles of the brain were found to be enormously distended with perfectly transparent serous fluid, the quantity of which was not measured, but must have amounted to at least half a pint; one of the ventricles was in fact accidentally opened by the saw in removing the skull-cap, although the brain was by no means deeply wounded. The convolutions of both hemispheres were so much flattened by the pressure, that the sulci between them were entirely effaced. On pursuing the examination, the explanation of this state of things was found in the condition of the venæ Galeni, which were flattened, and contained no blood; the return of blood through them had been obstructed by the pressure of under-lying disease, and dropsy of the ventricles had resulted. A few transparent and very minute granulations, which were only visible when looked at obliquely, were scattered over the arachnoid at the base of the brain. With this exception, the state of the cerebral membranes, whether of the surface or ventricles, was perfectly normal; they presented no trace of inflammation, and the structure of the brain itself was sound. The inferior surface of the right lobe of the cerebellum was attached to the dura mater by slight adhesions. On further examination, this lobe was found to be the seat of three distinct abscesses; two of which were situated

between a duplication of the deep folds which traverse the lower surface of the cerebellum. It is important to remark in reference to the history of the case, that their presence involved no breach of fibre or other structure, although from their size they must have exerted severe pressure on the surrounding parts. One of them was about the size of a Spanish nut, the other would easily have contained a large walnut. Both were lined by a distinct membrane, of new formation, to which a somewhat thick layer of concrete pus was adherent. These characters were best marked in the smaller of the two abscesses, which, if any inference may be drawn from such appearances, appeared to be the older of the two. The third abscess was still larger, and was formed at the expense of the substance of the cerebellum itself. The central part of the right lobe was almost entirely converted into pus, so that the whole of this lobe might be represented as a bag of matter whose walls were formed by grey substance. The small portion of white substance still remaining was broken up, and consisted chiefly of diffluent pulp. At one point, corresponding to the root of the rhomboidal body, a small extravasation had occurred. This abscess was lined by no membrane, and had no definite wall, the part in which the suppuration was complete shading off gradually into broken-up nervous tissue. The pus it contained was also much more fluid than that of the other abscesses. From these characters there can be little doubt that it was the most recent of the three. The left lobe and other parts of the cerebellum were free from disease. On examining the interior of the skull itself, a yellow spot, about the size of a pea, was discovered over the petrous portion of the right temporal bone. The dura mater was here separated from the skull beneath by a thin layer of concrete pus lying upon the carious bone; but there was no trace of inflammation or other disease in the cerebral aspect of the membrane. Over this space the bone was destroyed in its whole thickness, so that, on lightly scraping it with a scalpel, the cavity of the tympanum was brought into view. This cavity was filled with opaque lymph, of a reddish yellow colour, but on its removal the proper bones and muscular apparatus of the ear were seen to be still in place. The membrana tympani was slightly thickened and opaque; but with this exception was sound, as was also the meatus externus. It was ascertained that the lungs were free from tubercle, and the

heart healthy; but the other viscera were not minutely examined."

Upon carefully inspecting the bone, it was evident that this case formed no exception to the general rule laid down by me, that when disease, beginning in the mastoid cells after the second or third year of life, injures the brain, the cerebellum is the part affected; for it is clear that the part principally involved lies posterior to the small bones, and that it is in reality included in the mastoid cells.

This case gives rise to one or two other important considerations: and first as to the *duration of the disease of the ear*. Dr. Budd informs me, that the earliest history he had of any affection of the ear was, that two months before the fatal illness, the boy had been kept from school for two days by a slight ear-ache, but the attack seemed to go off. This attack of ear-ache followed an illness supposed to be scarlatina, and it is probable that the attack was the exciting cause of the urgent symptoms; but considering the carious condition of the petrous bone, and the presence of the abscess in the cerebellum, there can, it appears to me, be but little doubt that the disease, in a chronic form, had been in existence for a considerable period. In a letter to me, Dr. Budd says, "It is difficult to find a satisfactory reason why a carious condition of the posterior part of the petrous bone should give rise to abscess in the cerebellum, and caries of the superior part to abscess in the cerebrum; but it seems to me that the difficulties are fewer under the supposition that the disease is generally propagated by the veins than under any other. In the case of George Bell, the notion of propagation by direct proximity was out of the question; for not only was the carious bone at a considerable distance from the cerebellum, but no morbid change of any kind could be detected in the cerebral aspect of the dura mater covering the carious part. Many other reasons, if necessary, could be given for believing that in this and many similar cases, the veins were the channel of the mischief. That it should have had (as under this supposition it would) to run counter for some distance to the current of the blood is no real difficulty; since in the inflammation of the femoral vein which is set up by diseased conditions of the uterus, and still more by intestinal ulcer, we have undoubted and frequent examples of such a course: it would at the same time

be going too far to deny that in some cases, especially where the abscess is seated in the brain, the disease is propagated by direct continuity." Several cases have been seen by me in which, in a spot exactly corresponding with the cerebral mischief, the dura mater was either ulcerated through, or manifestly diseased. From the peculiar discolouration of the parts in many such cases, I should suppose the putrefactive decomposition of the carious discharges has much to do in the extension of the disease. With regard to the mode in which the disease is propagated from the ear, there appears to me no doubt that the dura mater is affected by *direct continuity*. To the lateral sinus there seems abundant evidence that it is communicated by the blood-vessels; and although it is impossible to disprove the statement of Dr. Budd, that the disease extends to the brain through the blood also, it has always appeared to me probable, that the existence of an abscess in the bone has by sympathy caused a similar disease to be developed in the brain. It is quite certain that it does not take place by continuity, inasmuch as a considerable layer of healthy brain often intervenes between the petrous bone and the abscess in the cerebrum.

It has been before stated, that disease of the mastoid cells produces death by causing suppuration of the lateral sinus, inflammation of the membranes of the cerebellum, or an abscess in the substance of the latter; cases are, however, sometimes met with in which the pneumo-gastric nerve is affected as it emerges through the foramen lacerum posterius. A case of this kind occurred to Mr. Coe, of Bristol, and was brought before the Bath and Bristol Branch of the Provincial Association, in December 1854. I give it in Mr. Coe's words:—

Case VIII. *Disease of the mastoid cells, advancing to the lateral sinus and pneumo-gastric nerve.* — "An out-patient of the Bristol General Hospital came under my care, complaining of running at the right ear, which had existed for some years, and occasional paroxysms of acute pain in the ear and head whenever the discharge ceased for a time, such being the case at the period of application. Leeches were applied to the mastoid process, and warm fomentations to the side of the head, and mercury was given internally. On the next day symptoms of meningitis having come on, the patient was taken into the house. He progressed favourably for some days; but afterwards began

to complain of stiffness and pain in the right side of the neck, and sudden attacks of difficulty of breathing, as if from spasm of the glottis. There was a distinct rope-like swelling descending from the base of the skull, down the side of the neck, in the situation of the carotid sheath: it was very tender to the touch.

"The diagnosis was caries of the posterior portion of the temporal bone; meningitis; obstruction of the right lateral sinus, either from extension of inflammation or from secondary purulent deposit; subsequent coagulation of blood in the internal jugular vein; inflammation of its sheath, with involvement of the pneumo-gastric nerve, especially the inferior laryngeal nerve (the phenomena of the irritation of this branch, being, at any rate, more manifested than of any other portion of the nerve).

"The correctness of the diagnosis was proved by the *post-mortem* examination."

Mr. Leonard, of Bristol, brought forward a case at the same meeting, in which the pneumo-gastric nerve was implicated, and it is interesting to find that the cases of these gentlemen are considered by them corroborative of the opinion advanced by me, "that the parts of the encephalon, secondarily affected in caries of the petrous part of the temporal bone, vary according to the situation of the caries."

In concluding this account of the pathology of the mastoid cells, let me glance at a peculiarity sometimes met with in these cases, viz., their being attended with symptoms exactly resembling remittent fever.

Dr. Griffin, in the *Dublin Journal of Science*, published two cases of the kind. One of them, which is also cited by Dr. Watson, is as follows:—

A young man, previously healthy, was attacked with fits of shivering, accompanied by pain in the left side of the head. At first the paroxysms were rather irregular, but they soon assumed the form of *tertian ague*, coming on every other day, at about the same hour; the cold fit commencing at noon, and lasting about half an hour, followed by a hot stage of somewhat longer duration, and terminating in a profuse sweat. In the intermissions the pain in the head was trifling; there was no thirst nor heat of skin, but he did not sleep. A tumour formed over the mas-

toid process of the left side, and was opened, and a quantity of extremely offensive brownish pus sprang out with great force. This gave much relief. The bone was carious over a space as large as a shilling. After about ten days, the pain in the head and in the mastoid process became very severe; the patient had violent shivering fits many times in the day, great thirst, heat of skin, vomiting, and delirium; his face was flushed, and his pulse hard; and he died within a few hours of the accession of these last symptoms.

(*c.*) NECROSIS OF THE MASTOID PROCESS.

On account of their position and peculiar arrangement, disease of the mastoid cells is usually of a more serious character than disease of the tympanum. The difference between the construction of these cells in childhood and in the adult has been already described, and it will have been seen that in each period of life, during disease, there is scarcely any possibility of the whole of the secreted matter being discharged from the ear.

In childhood, before the mastoid process is developed, the rudimental cells, as stated, are placed posteriorly and superiorly to the tympanic cavity, and are bounded externally by a portion of the squamous bone. In the instances already detailed of disease occurring in these cells during childhood, it has been shown that it advanced rapidly until it caused the death of the patient; indeed, in those cases the brain, or its membranes, were most probably affected long before the patient's friends applied for relief, and before the diseased portion of bone had become detached, or partially detached, so as to admit the free egress of the matter from the mastoid cells. An examination of a specimen illustrative of this branch of the pathology of the subject will show, that had the portion of necrosed bone, forming the outer wall of the mastoid cells, been capable of removal during the life of the patient, the progress inwards to the brain would probably have been arrested or averted. In the majority of cases of necrosis of the mastoid process which fall under notice among the out-patients of St. Mary's Hospital, the portion of necrosed bone does become detached before the membranes of the brain are affected, and frequently the mass of bone comes away with but very slight cerebral disturbance. Indeed, as a

rule, when the portion of necrosed bone is detached, although it may be of considerable size, there is very little fear of injury to the brain or the dura mater.

It is not always very easy to distinguish between disease in the tympanic cavity and that occurring in the mastoid cells. As a general rule, when the mastoid cells are affected, the pain is referred to the region of the mastoid process, or to the back of the head; tenderness is experienced upon gently tapping or pressing upon the mastoid process; the attacks of pain and giddiness appear more in the shape of sudden paroxysms, and the giddiness is more violent. It not unfrequently occurs that there is no perforation of the membrana tympani, though the disease in the mastoid cells causes irritation and catarrh of the dermoid meatus.

The following particulars relate to what may be considered one of the most favourable *cases* of caries of the mastoid process.

Chronic catarrh of the mucous membrane lining the mastoid cells; caries of the bone; removal of the dead portion; recovery. —Master W., aged 6, was brought to me on the 4th of September, 1853. His mother said, that four years previously, he had an attack of scarlet fever, followed by discharge from both ears, and by dulness of hearing. After the discharge had continued for three months, with pain at the back of the head, and frequent giddiness, an abscess formed behind the right ear, which being laid open, a portion of dead bone was felt, which gradually became detached and was removed. The discharge from the ear continued. On examination of the right ear, the membrana tympani was absent, and the meatus contained polypi. In the left ear, the membrana tympani was perforated; the mucous membrane of the tympanum was red, and poured out an abundant discharge. Posterior to this ear was a small orifice, through which, by means of a probe, dead bone was felt. This was the upper part of the mastoid process, which, by slow degrees, was detached and removed. After its removal, and the constant use of the syringe and warm water, the discharge disappeared.

A large number of cases, very similar in detail to the above, might be added. Sometimes the head symptoms are slight, at

others very marked. There is usually polypus in the meatus, resulting from the irritation of the dead bone. If it seriously interferes with the outward progress of the dead bone, the polypus may be removed; otherwise it will generally be found to disappear after the discharge of the bone. In many cases which have fallen under my notice, the portion of necrosed bone has been removed from the meatus, without any incision being made over the mastoid process: a plan which may usually be adopted, since the membranus meatus is capable of being greatly dilated, and the disfigurement is thus less than when an incision is made.

It not unfrequently happens, that the loss of a considerable portion of the mastoid cells is unattended with any more serious diminution of the hearing power than that accompanying simple catarrh of the mucous membrane of the tympanum, accompanied by partial or complete loss of the membrana tympani. Paralysis of the portio dura nerve is, however, a not uncommon result. This nerve, it will be remembered, passes internal to the mastoid process, and is apt to become involved in the disease of the bone, as in the following cases.

Catarrh of the mucous membrane of the tympanum and mastoid cells after scarlet fever; caries of the mastoid process; paralysis of the portio dura nerve.—Master C., aged 5, was brought to consult me on the 8th of February, 1853. His history is, that seven months ago he had an attack of scarlet fever, which was followed, a fortnight after, by a discharge from each ear, the loss of the small bones, and complete deafness, so that he does not hear a sound. On examining the right ear, the membrana tympani and ossicles were absent, the mucous membrane of the tympanum was red and thick, and pouring out a copious discharge of mucus.

Left ear.—The meatus contains a large polypus, below which is a portion of necrosed mastoid process, that moves on being touched with a probe. The left portio dura nerve is paralysed. The course of treatment recommended consisted in the use of a syringe and warm water daily, and in the administration of tonic medicines. In the course of a fortnight, the portion of dead bone gradually worked its way to the orifice of the meatus, and was removed; it was about half an inch in length, and a

quarter of an inch in breadth. After the bone was extracted, the polypus disappeared, and the discharge ceased.

Sometimes, as in the next case, the cerebral symptoms are of great severity.

Caries of the mastoid cells; severe cerebral symptoms; paralysis of the portio dura nerve.—Miss J. S., aged 6½, pale and sickly, was brought to me on the 14th of August, 1850. Her mother stated, that a day or two after her birth a discharge was seen to issue from the tube of each ear, but more abundantly from the left. The right ear recovered, except a slight occasional discharge, but it was constant on the left side; and at the age of two years was followed by an abscess at the back of the ear, accompanied by violent pain in the back part of the head, giddiness, and partial insensibility. After the abscess had remained open between two and three months, a rounded portion of dead bone, of the size of a large horse-bean, came away, and about this time the child lost the use of the muscles of the left side of the face. When seen by me, there was so great a dulness of hearing that she had to be loudly spoken to within the distance of a yard. The membrana tympani of each ear was absent; the tympanic mucous membrane was red and thick, and there was a depression behind the left ear, from which the piece of dead bone had been removed. The treatment pursued consisted in the use of frequent injections with warm water, followed by mild astringents. Gentle counter-irritation was kept up behind each ear, and tonic medicines administered. Under these plans the discharge gradually subsided, and the power of hearing somewhat improved.

Treatment in the adult.—In the adult the mastoid process rarely comes away in a considerable portion; and the outer surface is so dense, that the only way in which discharge escapes from the interior is through a small fistulous orifice. The inner wall of the mastoid cells is usually the first to yield, and the sulcus lateralis is partially or wholly destroyed, as has been shown by cases already quoted. The cause of the inward progress of the matter is, doubtless, the difficulty of its escape outwards. In some cases where the membrana tympani has been wholly destroyed, and where the mucous membrane of the tympanum is not so thick as to close or very much diminish the aperture from the mastoid cells, a

certain quantity of the matter can escape through the tympanum into the meatus; but often the membrana tympani is either entire, or, as in one case already cited, its lower margin is attached to the promontory, and effectually precludes the escape of the discharge.

It is unnecessary to repeat the remarks already made as to keeping an opening in the membrana tympani. When that membrane is evidently preventing the egress of the matter, and where the irritation produced by the operation is not to be feared, there can be no harm in trying the effect of a puncture. Perforation of the mastoid process also suggests itself, and this operation may, doubtless, be performed in those cases where the matter is pent up in the cavity of the ear, and is causing such urgent and serious symptoms, as are likely, if not relieved, to terminate in death. I have never performed this operation, but I should not scruple to do so in a case where the life of the patient was threatened. Considering the large extent of the mastoid cells, it appears to me, that the best plan of operating would be to use a trephine over the middle and posterior part of the process, and to remove a portion of bone three quarters of an inch in diameter. It might be imagined, that when the disease has advanced so far as to produce coma, all attempts to give relief by making an outlet for the matter would be ineffectual. Such, however, is not the case; for in one instance related by Dr. Abercrombie, a young lady who had laid for three or four days in a state of perfect coma, and whose situation was considered to be perfectly hopeless, was immediately and permanently relieved by a sudden discharge of matter from the affected ear. Dr. Abercrombie adds, "It is, however, by no means certain, that in such a case as this, the discharge came from the cavity of the cranium; for there is reason to believe that extensive suppuration within the cavity of the tympanum is capable of producing symptoms of great urgency, especially if there should be any difficulty of finding an outlet."

The treatment, however, on which it seems to me safest to rely for promoting the absorption of the matter and preventing its secretion, so as to bring back the ear to a more healthy condition, is counter-irritation, combined with plans for improving the general health. The following case thus treated is one of great interest, as from the symptoms manifest when the

patient was first seen by me, there is no doubt that both dura mater and bone were affected.

Disease of the mastoid cells; giddiness; great pain in the head; cured by the use of a seton.—R. D. M., a clergyman, aged 42, tall and thin, and not robust, consulted me on the recommendation of Professor Miller of Edinburgh. The history of the case is, that since a child, after an attack of ear-ache, has had discharge at times from the left ear until the age of 24; from 24 to 32 had but one attack of pain and discharge; between 32 and 35 had several severe attacks of pain at intervals of a few months; at the age of 35 had a severe attack of pain, after which such attacks became frequent, and the discharge became constant and fetid; at times serous, at others purulent or bloody. By degrees fits of confusion and giddiness in the head supervened, leading to prostration of nervous energy, and a constant feeling (to use the patient's words) "as if he were on the brink of apoplexy."

About four months previous to consulting me, he exerted himself greatly in preaching on one occasion. On the same evening, he afterwards sat listening long to a speaker in a public debate, with his head resting on his right arm. On rising up, he was seized with giddiness and a numb feeling in the right arm, while his pulse was slow and labouring. He got home with difficulty; but, under the influence of rest and gentle purgatives, he speedily recovered. About two months afterwards the giddiness returned, but in a more persistent form, accompanied by double vision. He had a foul tongue, palpitation, and flatulency; and there was a fixed pain in both sides of the forehead over the frontal sinuses. The ordinary discharge from the ear continued, and the numb feeling in the right arm recurred, extending from the elbow to the fingers, and following accurately the course of the ulnar nerve. At this time he was treated with blisters behind the ears, but without much relief. A month before the patient came to me he was under the immediate care of Professor Miller, who stated that he was then relieved by food and stimuli and the administration of tonics. In a day or two the symptoms assumed a pericranic character; they were also intermittent, affecting the left side of the forehead, eye, and face, and were accompanied by stuffing of the nostril on that side. The treatment was then changed to

Fowler's solution, with an anodyne embrocation; and in ten days the pain, giddiness, and uneasy feelings in the arm all passed away. At the time of my seeing him he complained of occasional swimming in the head, pain in the ear, and fetid discharge, together with a sensation at the back of the left ear when he walked, as if there were an empty drum there—a sensation which was increased upon tapping the mastoid process. The pain extends over the head from ear to ear, and also over the back part of the head; and when the discharge is very abundant, he suffers from the extreme sensitiveness of a spot three inches posterior to the upper part of the ear. When he presses upon the left jugular vein, he feels a great weight at the back of the ear, as if something would burst.

On inspection, the surface of the meatus was observed to be red and denuded of epidermis; the upper and only visible part of the membrana tympani was also red, and evidently fallen inwards towards the promontory. The lower half of the membrana tympani was concealed by a polypus. The discharge was milky, and very offensive. Upon slightly blowing the nose with closed nostrils, the air passed through the Eustachian tube into the tympanic cavity; but it did not pass into the meatus; so that the membrana tympani was believed to be entire. The power of hearing was so deteriorated, that the watch was not heard; the crack of the nail was, however, distinctly perceived.

The diagnosis formed by me was, that there was a collection of pus, or of pus and mucus, in the cavity of the mastoid cells; and that, probably, the dura mater covering their posterior surface was partially affected. I had no doubt that the discharge from the meatus was purely sympathetic, and the result of the internal irritation; it certainly did not come from the seat of the disease.

Acting on this view of the case, I recommended perfect quiet, tonic medicines, and a bracing air; while a constant discharge was to be kept up, first behind the ear, and then between the shoulders by means of blisters. This treatment producing but partial benefit, in April 1852, about four months after first seeing him, I ordered a seton to be placed in the nape of the neck. For a time no good result followed, but in July the fetid discharge began to dry up, the power of hearing greatly im-

proved, and the nervous energy much increased. During the two years that the seton has been worn, the patient (to use his own words) has "enjoyed a considerable measure of health and comfort, and feels comparatively well and strong;" and he preaches regularly once a week. He is annoyed now and then by slight attacks of giddiness, which are supposed, however, to depend upon indigestion; and are, he adds, "quite different from the oppressed feeling on the brain which I had two years ago." Occasionally the hearing is clogged for a day or two, but this state gives way to the use of the syringe and warm water; the seton continues to discharge.

The above case has been cited at some length, because it so fully illustrates the peculiar symptoms of this affection of the mastoid cells, which is far from being uncommon; and because it shows the decided benefit which is to be obtained by counter-irritation long continued.

Before concluding the subject of treatment, I will offer a few observations on the relation between the presence of discharge from the ear and disease of the bone or brain. Patients sometimes come to complain of having been objected to at a Life Insurance Office, on account of a long-standing discharge from one or both ears; or an opinion is requested whether such a discharge is a valid cause against insuring a life. No doubt a discharge from the ear should always be regarded with suspicion; an opinion which is borne out by an inspection of the following table, showing the relation between the duration of the discharge and the acute symptoms. The cases are taken from a paper of mine in the *Medico-Chirurgical Transactions* for 1851.

Age of Patient.	Duration of Discharge.	Duration of Acute Symptoms causing Death.	Post-mortem Appearances.
42	35 years.	Pain in the head, ending in coma: five days.	Pus in the tympanum and labyrinth, and around the medulla oblongata.
17	12 years.	Pain in the head and ear: twenty-two days.	Pus in the tympanum and labyrinth; auditory nerve of a dark colour; purulent matter deposited on the medulla oblongata, crura cerebri, and pons Varolii.
		DISEASE IN THE CEREBRAL CAVITY.	
44	24 years.	Paralysis of the portio dura nerve a few days before death.	Dura mater covering the upper wall of the tympanum thick and ulcerated; bone carious; mucous membrane of tympanum ulcerated.
21	Occasionally for 14 years.	Violent pain in the ear and head; pain in the back and body; curvature of the neck backwards; delirium five weeks.	Tympanic cavity full of pus; a large abscess in right middle cerebral lobe.
23	14 years.	Pain in the top of the head, followed by cerebral irritation; ten months.	An abscess in the left middle lobe of cerebrum; dura mater detached from the petrous bone; the bone soft and carious.
10	5 years; also earache at times.	Headache, vomiting, chilliness, five days; was then convalescent; a day after intense pain in the ear came on, ending in death in five days.	An abscess as large as a small hen's egg in the left middle cerebral lobe; dura mater over tympanum very thick and ulcerated; carious orifice in upper wall of tympanum; tympanic cavity full of scrofulous matter.
Adult.	20 years.	Pain in the head for fourteen days; fever, coma, four days.	An abscess in the right middle cerebral lobe; dura mater ulcerated; upper wall of tympanum carious.
24	3 years.	Cerebral irritation; abscess under the temporal muscle; delirium, coma; some days.	An abscess in the left middle cerebral lobe; the dura mater partly detached from the petrous bone, thick and dark-coloured; the bone dark, but not carious.
14	12 years.	Severe cerebral symptoms, coma, death in a few days.	A large abscess above the petrous bone, communicating with the external meatus, through petrous bone and dura mater.
60	2 years, followed by intense pain.	Violent cerebral irritation during thirteen days.	Dura mater covering the petrous bone detached from it, and full of orifices; an abscess in cerebrum; petrous bone carious; tympanic cavity and vestibule full of pus.

Age of Patient.	Duration of Discharge.	Duration of Acute Symptoms causing Death.	Post-mortem Appearances.
15	6 or 7 years.	Pain in right ear; shivering; headache; abscess behind the ear; great prostration; ten days.	Coats of lateral sinus thickened; coagulum in sinus.
45	20 years.	Pain in the left side of the head during the night only; cerebral irritation; delirium; eight weeks.	The cavernous sinuses full of grey-coloured matter; mastoid portion of temporal bone carious.
27	Since early life.	Pain in the head, rigors, fever; an abscess over the mastoid process; stupor, coma; three weeks.	Lateral sinus full of pus; sulcus lateralis carious.
20	7 years.	Shivering, headache, and pain in the right ear, followed by abscess behind it; cerebral irritation; death in ten days.	Abscess in left lobe of cerebellum; sulcus lateralis carious; pus in lateral sinus; secondary abscesses in neck and right lung.
3½	2 years.	Pain in the ear and head; convulsions; great prostration; three weeks.	Caries of meatus externus and sulcus lateralis; pus in lateral sinus and jugular vein; abscess in neck; cerebellum soft.
9	At intervals for 5 years.	Pain in the ear and headache; abscess behind the ear; delirium; convulsions; five weeks.	Lateral sinus full of pus; sulcus lateralis carious, and its cavity continuous with that of the tympanum; purulent deposits in the lungs.
19	At intervals during 2 years.	Intense headache; tenderness of abdomen, great physical prostration.	Abscess occupying nearly the whole length of the right hemisphere of cerebellum; petrous bone carious and soft; tympanum full of pus; cerebrum healthy.
32	2 years.	Pain in the ear and side of the head; drowsiness, stupor, and coma; six weeks.	Abscess in right hemisphere of cerebellum; petrous bone carious; dura mater ulcerated.
Adult.	16 years.	Headache, stupor, coma; a few days.	Abscess in right hemisphere of cerebellum; external meatus and petrous bone carious.

It is true that many persons live long, having had, during the whole of life, a discharge from the ear without any disease of the bone: others live many years with a discharge, but at death the bone and dura mater are found affected, and might under many circumstances have assumed an active form of disease, ending in death. It is important, therefore, to be able to form an opinion respecting cases of the kind. To do this, it is first necessary to decide upon the source of the discharge. If it arises from the dermoid meatus, the membrana tympani being entire, there is, as before stated, most probably irritation in the tympanic cavity or mastoid cells, of which irritation the discharge is the symptom. Unless there were simply some eczematous state of the meatus to account for the discharge, and unless the hearing power were perfect, such a case should be looked upon with suspicion, especially if attended with any symptoms of brain or cerebral irritation. Again, if the discharge issues from the tympanic cavity through a small or a valvular opening, and it is requisite to blow the nose forcibly to clear out the tympanum, there probably is, or will be, some affection of the bone, from the accumulation of the discharge. If there is a large orifice in the membrana tympani, or that membrane is absent; if there is no ulceration of the mucous membrane of the tympanum; if there is some power of hearing remaining; and if by pressing and tapping the region round the ear, no pain is felt; and if there are no other symptoms of disease in the ear or head, I think it may be assumed that there is no disease of the bone; and that by attention to daily syringing, and the other plans alluded to when speaking of the treatment of these affections of the ear, there is a fair prospect of the disease remaining confined to the mucous membrane of the ear. On the other hand, it becomes a duty to state that any negligence on the part of the patient, by which the discharge should be allowed to collect so as to fill up the orifice in the membrana tympani—a blow on the ear, an attack of fever, or any severe illness, might cause an irritation in the ear, which, if unattended to, might advance to the bone.

CHAPTER XV.

THE DISEASES OF THE NERVOUS APPARATUS OF THE EAR, PRODUCING WHAT IS USUALLY CALLED "NERVOUS DEAFNESS."

a. DISEASES IN WHICH THE EAR ALONE IS AFFECTED:—1. FROM CONCUSSION—THREE MODES—BLOWS ON THE EAR—LOUD SOUNDS—FALLS. 2. FROM THE APPLICATION OF COLD—COLD AIR—COLD WATER. 3. FROM THE EFFECT OF MORBID POISONS—RHEUMATIC FEVER—TYPHUS FEVER—SCARLET FEVER—MUMPS—GOUT. *b.* DISEASES IN WHICH THE BRAIN AS WELL AS THE EAR IS AFFECTED:—1. MENTAL EXCITEMENT—OVER-STUDY—SORROW. 2. BODILY DEBILITY—WANT OF SLEEP—ACCOUCHEMENTS—OVER-EXHAUSTION IN HOT CLIMATES—FASTING—NEURALGIA.

THE nervous apparatus which receives the sonorous undulations from the tympanum, and conveys them to the brain—one of the most delicate structures in the human body—is liable to many functional and organic derangements.* As some cases of deafness dependent upon the derangement of the nervous apparatus connected with the organ of hearing, appear to be caused by the condition of the brain generally, or of that part in intimate relation with the acoustic nerve, it has seemed desirable to divide the nervous diseases of the ear into two classes: to the *first* of which belong those cases where the special nervous apparatus of the organ is alone affected; to the *second*, those where the brain, conjointly with the ear, seems to be injured.

The first class may be subdivided into diseases arising from—

(1.) Concussion.

(2.) The application of cold.

(3.) Various poisons: as that of typhus, scarlet, or rheumatic

* As I have nothing to add to the descriptions usually given of the anatomy of the labyrinth, I have not entered upon the subject.

fevers, of measles and mumps, of gout, of an accumulation of bile in the blood, and of quinine in large doses.

And the second into diseases arising from—

(1.) Excess of mental excitement.

(2.) Physical debility.

(*a.*) DISEASES IN WHICH THE EAR ALONE IS AFFECTED.

This section will be occupied with a review of the various kinds of disease comprehended under the first of the above classes, all of which are usually accompanied by more or less of congestion.

(1.) *Debility of the Nervous Apparatus of the Ear produced by Concussion.*

Concussion may arise in three ways; either from a blow on the ear, or from the effect of loud sounds, or from a jar of the whole frame. Affections of the nervous apparatus of the ear, as the result of blows on the external organs, are not very common, since, as a general rule, the membrana tympani gives way and is ruptured, and consequently the shock on the drum is so far modified in its effect on the ossicles and the fenestra ovalis, that the contents of the labyrinth receive no greater injury than that which causes a slight dulness of hearing for a few days.

Cases of more permanent injury to the acoustic nervous apparatus do, however, sometimes happen from the effects of a blow on the ear, as in the following case.

Injury to the nervous apparatus of the ear, produced by a blow on that organ.—A physician in London, while playing with his little children, suddenly brought his right ear into contact with the head of one of them, causing a rather severe concussion on that side of his own head. The concussion was instantly followed by a singing in the ears. I saw the patient soon after the accident, but could detect no unnatural appearance in the membrana tympani; and on carefully testing the hearing power by the watch, there appeared to be no dulness of hearing. This physician has been seen by me from time to time since the accident, and he tells me the singing remains as it was on the day the concussion took place.

The nervous apparatus of the ear is frequently injured also from the effect of a general concussion of the body, in which case the hearing power is often entirely destroyed. The well-known instance of the late Dr. Kitto, who was rendered wholly deaf by a fall from the top of a house when a boy, may be noticed in illustration, and some others follow which have fallen under my own observation.

Fatal deafness in the right ear, and partial deafness in the left, following a fall from a horse.—The Rev. R. F., aged 53. During many years his hearing has been dull during a cold. Five years before seeing me, he had a fall from his horse, and the fall was followed by a discharge of blood from the right ear for the space of two days, and subsequently of matter. For some days after the accident, the air whistled out of his right ear whenever the nose was blown. Since the accident the right ear has been entirely useless, and the left so deaf that he has to be loudly addressed within a yard of that ear. There has also remained a constant singing noise in the head. On inspection, the hearing of the *right ear* was found to have been wholly destroyed, and the membrana tympani presented an orifice, the margins of which were opaque and uneven. *Left ear.*—The membrana tympani was dull on its surface, and in parts calcareous.

In some instances, slight amelioration of the deafness following the accident takes place, as in the next case.

Total deafness in the right ear following a fall from a phaeton; gradual improvement.—The Rev. J. L., aged 35, had a deafness in the right ear during a cold four years ago. In the same year he fell from a phaeton, and was unconscious for some days. When he recovered his sensibility, he found that there was a hissing sound, like that from a tea-kettle, in the right ear, which was completely deaf. During two years, however, subsequent to the accident, the power of hearing gradually improved, so that the patient is able to hear a loud voice with that ear. The noises still continue, and are aggravated by wine, or by bodily or mental fatigue; when writing or studying, these noises become overpowering, but in the morning are much lessened. On inspecting the *right ear*, the air is distinctly heard by me to enter the tympanic cavity, but the patient experiences

no sensation in the ear when it enters. A loud ticking watch is heard. When spoken to through a trumpet, loudly and slowly, the voice is heard, but not till a second or two after the word has been uttered. The membrana tympani was opaque.

The violent shock communicated to the nervous system of the ear (most probably through the medium of the membrana fenestræ rotundæ) in the act of coughing, sometimes produces deafness; indeed, in some cases, hooping-cough seems rather to cause deafness by this means than by the agency of poison.

Nervous system of the ear injured by violent coughing.— Mrs. A. consulted me in 1851, and stated that a week previous to her visit, directly after coughing, she experienced a pain in the left ear, which lasted for two hours, together with a loud singing noise which has never ceased. She complains of an unpleasant sensation as if sounds passed through the ear, and is troubled with a sense of giddiness, and a feeling of confusion in the head. Every step she takes sounds like the beating of a drum. The membrana tympani was fallen in, and its surface dull. The watch was heard only when in contact with the ear. Means having been used to diminish the congestion of the nervous apparatus of the ear, the distressing symptoms of nervousness and giddiness disappeared, but the singing sounds remained.

The concussion upon the nervous system of the ear resulting from loud sounds is a very common cause of deafness. In a previous part of this volume, when speaking of the functions of the ossicles and muscles of the tympanum, it was shown that the one use of the tensor tympani muscle is to render tense the membrane of the fenestra rotunda, as well as that of the larger membrane; and in this tense condition the membrane of the fenestra rotunda is thrown into vibratory movements of much less extent than when it is in a relaxed state. When a loud sound is anticipated, the tensor tympani muscle draws the membrana tympani and the membrana fenestræ rotundæ tense; so that, when the approach of a loud sound is expected, it rarely injures the ear. On the contrary, however, when both membranes are comparatively lax, the same sounds throw them into very extended vibrations, and the fluid in the cochlea by the magnified movements of the membrana fenestræ rotundæ is so

concussed as to injure, and often most seriously, the expansion of the auditory nerve in the labyrinth.

Injury to the nervous apparatus of the ear may be produced by a variety of sounds. Cases have been seen by me in which a cannonade at land or sea, or the firing a single cannon, has produced the injury; and others have occurred where an explosion of gas, thunder, a pistol shot, or even loud shouting near the ear, have resulted in the same effect; but the most common cases are those which follow the long-continued sport of shooting, where the deafness almost invariably occurs in the left ear, which is turned towards the gun during its explosion, and consequently receives the direct concussion.

The *treatment* in recent cases, when the patient is suffering from the immediate effect of the shock, consists in the removal of the congestion by the application of leeches, or by cupping; by the administration of mild aperients; by strengthening the general nervous system as much as possible, and by securing the ear against the effect of loud sounds.

Noises in the ears, deafness, and a feeling of deadness in the head, following the sound of a pistol shot; relief. — Mr. C. S., aged 45, a fortnight before consulting me, fired a pistol, for the first time in his life, in the open air on a cold frosty day. The concussion was instantaneously followed by a hissing noise in each ear, but more especially in the right, and he also felt a shock throughout the whole of the head, followed by a "feeling of deadness" in it. Since the accident he has been dull of hearing, and has observed, among other things, that he could not hear "the ring of money." Leeches and mustard plaisters were applied behind the ears, and small doses of calomel and colocynth were administered. Immediate relief to the head and ears followed the application of the leeches, and in a week the hearing had improved, and the noises diminished.

Nervous apparatus injured by the report of a cannon.— W. L. C., Esq., aged 73, about four months before consulting me, his hearing being then perfect, was sitting in the open air at Brighton, looking upon the sea, when a cannon near where he sat was fired, without his having any idea of such a proceeding being about to take place. The concussion was immediately followed by a singing in the ears, or rather about two yards

from them, and a sensation as if water were rushing through them. Since the accident he has heard a whisper very distinctly, but a loud voice causes unpleasant jarring sensations in the ears, and deafness to all sounds. In another case, the ear was "benumbed" for some time after the patient's child had shouted into it.

Nervous apparatus of the ear injured by very loud shouting; very distressing noises; great relief.—When surgeon to the St. George's and St. James's Dispensary, a poor man applied to me for relief from deafness and very distressing noises in the left ear. The latter had lasted several years, and the patient, a strong muscular man, thinks they were caused by the loud shouting he is obliged to practise as a hawker of fish. These noises came on in the left ear, and after remaining there some time advanced to the left side of the head; they have increased lately, sometimes resembling "a rapid tinkling," at others being like the driving of a sledge hammer; but most commonly they resemble the roaring of the sea. When at their loudest, as after exertion, the house seems to go round with him. The ear is quite insensible to any sound but that of these noises. The right ear is healthy. On examination the membrana tympani of the affected ear was found to be opaque, and the air passed through the Eustachian tube with a loud crackling. As this was a local affection, as the patient was a strong man, and as the symptoms were increased by any cause which increased a flow of blood to the organ, I determined to treat the case as one of congestion, and accordingly ordered the patient to apply twelve leeches below the ear, followed by a cantharidine cerate dressed with unguentum hydrargyri, at the same time that the outer half of the meatus was washed with a solution of nitrate of silver sufficiently strong to produce desquamation. This was followed by the use of a solution of chloride of zinc (six grains to the ounce) to the meatus, so as to cause a discharge. The result of this treatment was satisfactory. The noises, the patient says, "have not been so loud or nearly like it:" and ten days subsequently to this report, he said that his head was much better, and "he could do his work without being obliged to give up."

Nervous apparatus of the ear injured by the explosion of bladders of gas.—J. B., aged 64, was admitted under my care at

St. Mary's Hospital in 1853. He stated that nine months previously, directly after the explosion of two bladders of gas at the distance of a yard from his head, he suddenly became so hard of hearing, that he could not hear a voice except when spoken to distinctly at a distance of two yards from the head. The explosion was followed by a singing sound in the ears, which gradually subsided. The watch could not be heard at a distance of more than two inches from the right ear, and only when in contact with the left. The treatment consisted in the application of leeches below the ears, but the patient did not return to report progress.

The following is a well-marked case in which the nervous apparatus was injured by shooting.

Deafness in left ear following shooting, and temporarily increased by a day's sport.—F. F., Esq., aged 23, accustomed to shoot, has been gradually becoming dull in the left ear. For two years he has not been able to hear general conversation distinctly, and the striking of the clock seems no longer attended by the natural sound. Is more dull of hearing during a cold. Is not aware of any cause that could have produced the deafness. The right ear was in a natural state; by the left the watch was only heard at the distance of half an inch. The treatment consisted in the use of gentle counter-irritants over and around the ear, and in doing all that could be suggested for diminishing local and general congestion. This treatment was followed by great improvement at the end of about three weeks, when the watch could be heard at a distance of four inches—an improvement which continued, with the exception of a considerably increased amount of deafness which ensued upon a morning's shooting. This increased deafness continued for some days, and then gradually diminished. The last time the patient was seen by me, the hearing had not regained the previously improved state, for the watch could only be heard in contact with the ear.

Not having had the opportunity of ascertaining the condition of the ear by the aid of dissection, I have assumed that in these cases, arising from shooting, the nervous system of the ear is defective. The grounds of this conclusion are, that the noises and defective hearing followed *immediately* on the concussion, and all the symptoms indicated that a shock had been given to

the nervous system. The *secondary* effect of this concussion, it can scarcely be doubted, may be anchylosis of the stapes to the fenestra ovalis. In cases, indeed, when the nervous system of the ear has received a very severe concussion, and deafness has subsequently slowly come on, I have convinced myself of this anchylosis by dissection, and will now relate one or two cases of the kind.

Concussion of the nervous apparatus of the ear by thunder; complete deafness.—T. D., aged 80, is so completely deaf that he cannot hear any sound. He states that, fifteen years ago, when in a thunder-storm on the coast of Guinea, he was rendered thoroughly deaf by a clap of thunder, and since then has not heard a sound. On examination, an orifice was observed in each membrana tympani. No treatment was attempted, but about two years after the examination, the opportunity was given me of dissecting his ears, which were in the following morbid condition.

Right ear.—At the posterior part of the membrana tympani was an orifice about two lines in diameter, the remaining portion of the membrane being white, thick, and tense, and more concave externally than natural: parts were also calcareous. In the centre of the remnant of the membrana tympani is a space about half a line in diameter, in which the epidermoid, dermoid, and mucous layers alone remain. The long process of the incus and the crura of the stapes are gone, and the expanded base of the stapes is attached to the fenestra ovalis more firmly than natural. The membranous labyrinth was atrophied, and the nervous fibrillæ of the cochlea appeared the same.

Left ear.—Like the right; except that the crura of the stapes were only partially absorbed.

In another case of total deafness produced by a loud cannonading, the only morbid condition that could be detected by me, on dissection, was that the otoconie was more abundant than natural, while in the vestibule there was a deposit of oval-shaped cells.

Results similar to those noticed as following the practice of shooting, also occur to operatives engaged in occupations involving very loud sounds. Thus in a large factory for making steam boilers I found a great number of men engaged in riveting the bolts, and therefore obliged to work inside the boiler,

who were very deaf. It will be very interesting to ascertain by post-mortem inspection the pathological condition of the ear when subjected to such loud sounds, and some day perhaps the opportunity will be afforded me of doing so.

(2.) *The effect of the application of cold on the nervous apparatus of the ear.*

There are two classes of cases in which a diminution of the temperature is found to be injurious to the ear: in the one cold air, in the other cold water, is the agent producing the effect. I have known engine-drivers to suffer from deafness after being exposed to a cold blast, and huntsmen also who have had a sudden "check" when very hot, and have then stood about while a bitter east wind was blowing upon them. The effect of the application of cold seems, in the first instance, to produce congestion; and then to lead to the symptoms of noise in the ear and of deafness, which appear to depend upon a depressed or depraved action, subsequent to and resulting from the congestion. In what the depraved action consists, it is, however, difficult to determine. The congestion often yields to the application of leeches; and the depraved action is frequently diminished, sometimes wholly removed, by the use of gentle counter-irritants, tonics, shower-baths, &c.

The first series of cases consists of those in which the injury followed exposure to cold air.

Total deafness in both ears following exposure to cold by sleeping in the open air.—A farm-labourer, aged 28, was admitted under my care at the St. George's and St. James's Dispensary, in June, 1850, on account of complete deafness in both ears. He said that eighteen months previously, after sleeping in an open cart in which he was riding in the winter, a usual practice with him, intense pain came on between the right temple and ear, which was relieved by the use of veratrine ointment. About three weeks after the exposure to cold the deafness made its appearance, at first for a day or two only, and then disappeared: in the course of a few days, however, it recurred with increasing intensity and once more disappeared. This recurrence and disappearance of the deafness ended after a few more days in total and permanent loss of hearing. At the present time he cannot hear a gun, even if fired close to the

head. He complains of loud noises in the head, and of great heaviness and sleepiness. All kinds of empirical treatment had been tried on him; oils of various kinds had been dropped into the ears, with brandy and salt, and then hot baked salt behind them; every species of medicine had been given, and he had been cupped and blistered at the nape of the neck, but without producing any good effect. On examination, the upper part of each membrana tympani was found to be red, the lower part being concave and white; air entered through the Eustachian tube and caused a loud cracking sound. Some relief to the head symptoms followed a discharge from each meatus, which was kept up by the application from time to time of the chloride of zinc.

Deafness and singing in the ears following exposure to cold while skating.—J. V., Esq., aged 49, consulted me in March, 1852. His health was good, and his constitution strong. He stated that twelve or fourteen years previously, while skating on a bitterly cold day, a singing sound suddenly came on in the left ear, which has remained ever since; being at times very loud, and then much subdued. A few years after this exposure, the left ear became gradually dull of hearing, and recently both the singing and dulness of hearing have increased. The power of hearing varies, but is not worse after fatigue or excitement. With the right ear, the hearing distance was three inches; with the left, half an inch only. Two leeches were ordered to be applied below each ear, and the ears to be syringed with warm water, the object being to remove congestion. This treatment was followed by relief; but with the further progress of the case I am unacquainted.

Two other cases of injury produced by the application of cold air to the ear may be briefly alluded to. The first was that of a gentleman, aged 21, who ten months before my seeing him, being exposed to a very cold February wind, blowing in the left ear, had a singing and pulsation ensue within that organ; these sensations are unaccompanied with deafness, and are worse while in bed or reading. At times they wholly disappear. The second case is that of a clergyman, aged 66, who having been exposed to cold in a railway carriage, three years before my seeing him, was subsequently attacked by a whizzing sound in the left ear, which has never ceased. By sitting up late at night, or by entering a warm room from the cold air, the sound

is increased, but is better rather than worse after dinner. Complains of dulness of hearing, as general conversation is not heard.

The following are cases where the application of cold water resulted in injury to the ear :—

Deafness following bathing in cold water.—T. F., aged 19, saw me on account of his deafness. He said, that more than a year previously deafness came on slowly, after bathing daily in cold fresh water, and in a month or six weeks he became as deaf as at present. The affection has been stationary for some months. He requires speaking to loudly within the distance of a yard, and at times suffers from a buzzing in the ears. He is not deafer during a cold, and does not hear better in a carriage. The right ear is rather worse than the left. The previous treatment consisted in dropping oils into the ears, and in syringing them with warm water. In each ear the watch was heard only when in contact. The membrana tympani appeared to be slightly more concave than natural, and its surface was dull and congested. The treatment consisted in the application of a vesicating paper behind each ear, and in taking small doses of blue pill and iodide of potassium, a treatment which was followed by a slight amelioration of the symptoms.

Deafness produced in two days by dipping the head in cold water.—A girl, aged 14, the daughter of a farmer, consulted me in 1853. She stated, that two years previously, when very much heated, she plunged her head into cold water, and two days afterwards became so deaf that she required to be loudly spoken to close to the head. The deafness varies slightly, being worse during a cold, and at times, from no assignable cause, better. The treatment consisted in keeping up a slight discharge from the surface of each mastoid process, and in giving small doses of the bichloride of mercury (one-thirtieth of a grain) with gentian, daily. The treatment, pursued during two months, resulted in decided improvement.

Deafness and noises in the ears after bathing.—A man, aged 29, was admitted under my care at St. Mary's Hospital, in July, 1853. He said, that six years before, after bathing in a canal of cold fresh water, he became rapidly deaf in both ears, and in the course of a week was so deaf as to require to be distinctly spoken to quite close to him; complained from the first of buzzing noises and pulsations. The deafness

and the noises increase in damp weather, or when he is tired; and he also hears worse in a carriage and amid loud sounds. The treatment consisted in the application of gentle counter-irritants over each mastoid process, and in taking alteratives, but without any beneficial effect.

(3.) *Deafness produced by the action of morbid poisons on the nervous apparatus of the ear.*

As has been stated, in addition to the causes just detailed, the nervous apparatus of the ear often suffers from the action of the poisons of gout, typhus fever, scarlatina, measles, or mumps. Though unable to furnish any information of the *modus operandi* of the several poisons enumerated, in some cases where the functions of the organ have been wholly destroyed, the nervous apparatus of the ear, on dissection, has been found by me completely disorganized, and the fluid in the cochlea and vestibule dark-coloured, and occasionally tinged with blood. Many of the cases of acquired deaf-dumbness originate in the effect of poisons of various kinds. A careful consideration of the symptoms attendant upon these cases, and the results of treatment, indicate that whatever may be the immediate effect of the poison on the nervous tissue, the secondary effect is to produce congestion of that tissue.

Noises and deafness after rheumatic fever.—Miss B., aged 36, consulted me in 1851. She stated, that ten years previously she had an attack of rheumatic fever, which was followed by dulness of hearing in the right ear, and accompanied by a constant whizzing sound and a pulsation which extended over the head. The left ear has lately become dull. The watch was heard only when pressed upon the right ear, or at a distance of six inches from the left. Neither ear presented any appearance of disease, except a slight dulness of the surface of the left membrana tympani. The treatment consisted in applying mustard plaisters and stimulating liniments to the nape of the neck, and the etherial solution of cantharides behind the ears. The result of two months' perseverance was such an improvement of the hearing power, that conversation could be more distinctly perceived, and the watch could be heard at half an inch from the right ear.

Total deafness following an attack of rheumatic fever.—Mr.

M. G., aged 17, a year and a quarter before consulting me, had a bad attack of rheumatic fever, which was followed by noises in both ears and gradually increasing deafness, so that in a month after the fever he could not hear any sounds. Since the attack, has now and then heard loud sounds for a very short time; but when he saw me he was so deaf that he could not hear anything, even when the poker and tongs were knocked against each other. The ears had been syringed, blistered, and galvanized without any effect. There was no appearance of disease in either ear. The case was at once regarded by me as incurable.

Partial deafness following an attack of typhus fever.—Miss A. M., aged 16, saw me on March 1st, 1851. Eleven years previously she had an attack of typhus fever, and during the illness became so deaf as not to be able to hear the human voice. After the symptoms of fever had disappeared, the power of hearing slowly returned, until she was able to hear when loudly spoken to close to the head. There was no appearance of disease in either ear.

Partial deafness following fever.—P. A., Esq., aged 49, consulted me in December, 1853. Twenty years before, he had an attack of fever, during and for some time after which he was so deaf as to require to be spoken to close to the ear. The hearing gradually returned, and at the end of two years he heard perfectly well for a very short time, when the deafness as gradually returning, he soon had to be loudly spoken to within a yard of the head. Does not now complain of noises, but has had a ticking sound in the ears. The deafness is *worse* after flurry, excitement, or fatigue, after dinner, wine or beer; a single glass of either of the latter increases the deafness instantaneously. Is *better* after a discharge from the nose, and while riding in a carriage. The hearing power of the left ear is gone. On examination, no unnatural appearance was detected in either ear, and the watch was heard when pressed upon the right ear.

Total deafness following an attack of fever.—Miss C. J., aged 21, when a child had an attack of fever, since which time she has gradually become deaf, and at the present moment cannot hear even a loud clapping of the hands. Five years ago both tonsils were partially removed, and their remnants have recently been snipped, with no effect except that of producing

great mental depression. There was no appearance of disease in any part of the organ.

The poison of *scarlet fever*, like that of *typhus*, sometimes injures the nervous apparatus of the ear, and not unfrequently complete deafness is the result. The following are illustrative cases.

Dulness of hearing following an attack of scarlet fever.—Mrs. S., aged 26, had an attack of scarlet fever, eight years previous to consulting me, and since that time has been troubled with a dulness of hearing, especially during a cold. A year ago, after having suffered much trouble, and after being in weakly health, the power of hearing gradually decreased, and this decline was accompanied for the first time by pain with irritation and discharge in both ears, together with constant noises like the blowing of bellows. Is unable to hear general conversation, but a single voice is heard distinctly. The left ear is worse than the right. On examination of the right ear, the surface of the meatus was found to be dry and to contain small portions of epidermis; the membrana tympani was opaque, and the Eustachian tube pervious. The left ear was in a similar condition.

Complete deafness in the right ear produced by the poison of scarlet fever.—Mr. H., aged 20, had an attack of scarlet fever at four years of age, since which time the right ear has been so deaf as not to be able to hear even the slightest sound. On examination, the right membrana tympani was observed to be more opaque than natural, and the left ear was perfect in every respect.

Mumps.—The peculiar poison which causes the disease generally known by the name of mumps is very often the source of complete deafness, which, however, usually occurs in one ear only. In these cases the nervous apparatus is evidently affected, as the deafness comes on suddenly, is usually complete, and, as a general rule, no appearance of disease can be detected in the meatus, membrana tympani, or tympanic cavity. When the nerve is not wholly paralysed, and some, although it may be a very slight degree of, hearing remains, the only plan of treatment which can be recommended, is the use of gentle counter-irritation over and around the ears, at the same time that the ear is exercised by means of the elastic speaking tube.

The circulation of *bile* mixed with the blood is sometimes a

cause of deafness, and it is also well known that large doses of *quinine* are also liable to be followed by temporary deafness. I have met with only one case in which permanent injury to the ear was assigned to the use of large doses of quinine.

The poison of *gout* may also give rise to deafness and other peculiar symptoms in the head. In two cases of this affection which came under my notice, it is interesting to observe that the head symptom complained of, viz. a feeling of vacancy, was at once relieved by pressure upon the air contained in the external meatus.

Distressing sensations produced in the ears by gout.—D. T., Esq., aged 54, consulted me in June 1857. He said that for the last four or five years he had been subject to attacks of gout, which had at times caused him great inconvenience, and the disease had recently made so much progress as to make him fearful that his brain was weakened by its influence. He added that he was never really clear-headed excepting just after an attack of gout, when he supposed his blood was temporarily freed from the poison. He had rapidly aged in the course of the previous two years. An extremely distressing symptom had lately presented itself in the form of a peculiar sensation of vacancy in the ears, accompanied sometimes by a low humming sound. There was no deafness, and the patient applied to me only on account of the sensations in the ear. On examination, small deposits of gouty matter were observed in the substance of the right upper eyelid; the surface of the meatus externus was of a bright red colour; the circumference of the membrana tympani and of the long process of the malleus were also red; while the surface of the tympanic membrane was very bright. Air passed freely, and with the natural sound, into the tympanic cavity. The hearing power was perfect. By what, therefore, could the distressing symptoms be caused? Were they the result of congestion of the nerve?—a condition which, it seemed to me probable, might render the nerve so exquisitely sensitive, that the ordinary sounds ever floating in the air might become a source of excitement to the ear. Being aware also, from previous experience in similar cases, that pressure upon the external meatus so as to shut out or diminish the sound in the meatus would remove the symptom complained of, I closed with my fingers each external meatus, and the unpleasant symptoms at once

disappeared. On subsequently exerting a gentle pressure on the ears by the introduction of cotton steeped in water into each, the patient was enabled to leave in comparative comfort. For the purpose of preventing the recurrence of the symptoms, it was of course requisite to diminish the congestion, for which purpose two leeches were applied below each ear, small doses of colchicum administered, and strict attention to diet enjoined. The quantity of wine was decreased from four to two glasses daily, and in lieu of beef and mutton, of which he had been in the habit of partaking very abundantly, he was ordered to live principally on poultry, game, and fish, with abundance of farinaceous food and vegetables. The result of this treatment was the removal of the distressing symptoms in the ears, and the gradual disappearance of the attacks of gout.

(*b.*) DISEASES IN WHICH THE BRAIN AS WELL AS THE EAR, APPEARS TO BE AFFECTED.

(1.) *Debility of the nervous apparatus arising from mental excitement.*

A young lady, of about 25 years of age, is brought to me by her mother, on account of deafness in both ears, one being much deafer than the other. The patient is pale, rather thin, and has a look of depression. She complains of humming noises in both ears, and hears better in a carriage. Upon examination her pulse is feebler than natural, and the deafness is so considerable that she requires to be loudly spoken to within a yard of her ears. There is no morbid appearance in any part of the ear, and the Eustachian tube is in a natural state. On inquiring as to the origin of the deafness, the parent states that they had not been able to detect any cause. The deafness came on three years previously, when the young lady was in good health, and gradually increased, till in four months the patient had become as deaf as now. She is rather deafer after excitement and during fatigue. There is no hereditary tendency to deafness. The young lady has remained at home with her mother, has taken plenty of exercise in the open air daily, and retired to bed early; but, for some reason or other, her nervous system was not strong, and she was easily excited. On further questioning, it is found, that about the period when the deafness came on, the patient was particularly nervous, and ultimately it turns out, by her confession, that she had been deeply grieved

by the conduct of one of her friends, and had often lain awake at night indulging in sorrow, and that, at such periods, the noises came on in increased force.

Another young lady, aged 19, is brought just after leaving school, where she was well taken care of, and so liked by all, that she even preferred school to home. Her parents stated that six months before, without any apparent cause, their daughter had grown gradually deaf, and can at present hear only when very distinctly spoken to, within a distance of two or three yards. The deafness is worse during excitement. There is no appearance of disease in the ears, and the girl is strong, active, and healthy; her nervous system is, however, very sensitive, her feelings most acute, and she broods in silence over slight mental troubles which would pass unheeded by ordinary persons. Perhaps all attempts to find out the cause of the deafness are in vain; and the parents go away with the assurance from the medical man, that at the time the deafness first appeared there must have been some cause of mental excitement to call it forth. After the lapse of a shorter or longer period, the medical man learns, perhaps, that at the time in question the young lady at school suffered a great deal of mental anxiety, owing to her religious views being in an unsettled state.

These two cases are good types of the class of nervous deafness now under consideration. The causes may be very numerous, and in some instances are but slight, compared with the distressing symptoms which ensue; but it must be borne in mind that, as a general rule, the nervous system has, from a variety of causes, been allowed to sink into a weakened condition. Thus the child may have been overworked, have suffered from indigestion, had too little exercise or not enough sleep; ventilation also may have been defective. In a depressed state of health from any of these causes, an apparently slight additional cause may produce the injurious effect on the nervous system which has been indicated. Sometimes there is no diminution of the hearing power, and the patients complain not of deafness, but rather of singing noises, which are increased by any mental excitement. In some cases the noises are not constant, but only appear after mental emotion: the slightest unpleasant thoughts are sometimes sufficient at once to induce the noises.

The deafness and noises in this class of cases, if slight, can be cured by removing the cause (a depressed state of health), and by giving tone to the nervous system by tonics and by local applications to the ear. In some cases, however, of this species of nervous deafness, the symptoms of noises become so greatly aggravated, that unless their peculiar character had been detailed by several patients, it would be difficult to credit their existence. They may commence with a gentle singing, then increase to a hissing or whizzing sound, that suddenly changes to a series of sharp cracks, like pistol-shots, followed by a rushing sound like the wind, or the escape of steam from a boiler, after which a rolling may ensue like thunder. These sounds vary much in intensity, being increased in some by rainy weather, in others by an easterly wind; bodily fatigue may sometimes cause them to be magnified, but the source of increase is usually some discomfort or excitement of mind. A young lady, for instance, comes into my room with her mother to consult me, and she says that the noises became rather worse than usual when told that she was going to see a medical man; that they were accelerated when entering my house and waiting in the dining-room; and that they reached their acmé of intensity after the excitement attendant upon my examination of the ears, and questioning her about the symptoms. The important problem for consideration is, can the ears be improved? So far as my present experience extends, I may say that a large number of the worst cases can be but slightly influenced by treatment; but there is still a large number which may be very greatly benefited by measures calculated to brace the nervous system; as tonics, fresh air, exercise, and mental repose. In these cases I am giving electricity a trial.

Debility of the nervous apparatus of the ear, produced by over-study.—Lady D. brought her child to me in June, 1852. The young lady was twelve years of age, thin, rather tall of her age, and pale. The pulse was weak; the tonsils large and red; the mucous membrane of the fauces red, thick and rugous. The sub-maxiliary glands were somewhat enlarged, and she had been subject to glandular swellings in the neck. The appetite was good, and she partook freely of meat twice daily. She was taught at home with her sister by two governesses, one being for languages. She devoted between eight

and nine hours daily to her studies. The history given me was, that during the last two years, without any assignable cause, the power of hearing had gradually diminished, and there had been slight noises in the ears at times. On inquiry, it was elicited that she was greatly interested in her studies, and very anxious to make progress in them, never much tiring of her lessons. Her interest in them increased to excitement, and she was often agitated and distressed at not being able to accomplish as much as she desired. On examining the ears, a slight dulness was observable in each membrana tympani; the Eustachian tubes were pervious, but the hearing power was so diminished, that she required to be loudly spoken to within a yard of the head.

This deafness was at times so greatly aggravated, that considerable difficulty was experienced in making the patient hear at all. It was, therefore, palpable that there was considerable debility of the nervous apparatus of each ear, for which tonics were prescribed, also a gently stimulating embrocation; fewer hours were to be devoted to study, and light nutritious food, as game, poultry, fish, was to be taken instead of so much meat. All this resulted in some slight amelioration; but still the deafness was very considerable, and increased greatly at times. Under the circumstances, another consultation took place, at which I clearly traced the attacks of increased deafness to more than usual nervous excitement following more than usual mental work. In addition to the previous tonic measures, entire rest from study in any shape was enjoined for three months, during the whole of which time the hearing gradually improved, and at the end of six months the patient was declared to be perfectly well; and although she has resumed her previous plans of study, moderated according to circumstances, the case remains satisfactory.

To the above case the details of several others might be added, were not a brief allusion sufficient. Thus a lady, aged 27, consults me for deafness accompanied by noises which gradually came on during the previous four years. The nervous system never was strong, but underwent a severe shock, about the commencement of the period mentioned, from the breaking off of a matrimonial engagement. With the continuance of the mental sorrow the deafness and noises had gradually increased, and were always accelerated after much mental dejection.

Another lady of nervous temperament and warm feelings, was sitting at home awaiting the return of a brother to whom she was greatly attached, when he was brought home dead from a fall in the street. For the space of a year the sister gave way to despondency, and, as she told me, the thought of her brother during the whole year was scarcely a moment absent from her mind. At the end of that time, as her spirits began to improve, noises appeared in the ears and head, dulness of hearing followed, and both noises and deafness so greatly increased, that in the course of another year, when seen by me, she was so hard of hearing as to require to be loudly addressed at the distance of a yard or two, while the noises had reached a pitch of extraordinary excitement. There was scarcely any conceivable sound, whether of thunder, cannon, firing guns, bells, hissing, rolling of the sea against the beach in a storm, or winds howling, to which this lady was not subject. These sounds intermixed and alternated in a manner quite indescribable. They remained of the same general intensity, varying somewhat according to weather, for several years; when another severe domestic bereavement occurred, followed by some new noises of a still more intense character, but her deafness remained much the same.

Another lady, who married at about 26 years of age, was subjected to severe domestic trials, which, after preying upon her mind for some years, ended in such total deafness, that she could not hear a pistol-shot fired close to her head.

The variable amount of deafness in this class of cases is sometimes very marked. Thus I had for a long while a patient under my care who, when perfectly tranquil, could distinctly hear his daughter reading to him at about the distance of a yard; but if his daughter told him anything which excited his interest he became so thoroughly deaf as not to be able to hear a sound, and would remain so until the excitement vanished, when his hearing would return.

(2.) *Debility of the nervous apparatus of the ear produced by general bodily debility.*

It is difficult to draw a correct comparison between the number of cases of deafness dependent upon excess of mental excitement, and those arising from over-tasking the body; but from the data before me, perhaps those of the class now

to be considered are the most common. They occur in both sexes, but are more frequently met with in the female; and present great variety of form as well as cause. Sometimes they are temporary and produced by a long walk, heated rooms, late hours, &c., when noises, with diminished hearing power, come on, but disappear after rest. Other cases, and even some of those which come on suddenly, may, however, remain more or less permanent. Thus cases have been met with in my experience in which patients have become totally deaf after the administration of too violent a purgative, or after an attack of diarrhœa or cholera, and after the nervous exhaustion attendant upon childbirth; in some instances of the latter, the deafness has begun with the birth of the first child, and increased with each successive birth, until at last the nervous power was wholly lost. Perhaps the most common cause of nervous deafness from physical debility is the want of proper care in the management of young persons, and particularly girls, when they are growing fast. In hospital practice, young nursemaids who carry heavy children, and whose night's rest is often disturbed, and youths just entering laborious situations, are found to suffer. Any cause, in fact, which reduces the nervous energy of the body to a state too low for the due regulation of the functions of the various organs of the frame, may be followed by a manifest depression of the nervous power of the ears, which shows itself not merely in diminished power of hearing, but often by singing and other sensations in the ear, and sometimes by severe pain, like tic douloureux. In cases where debility of the nervous system of the ear is the result of a debilitated state of the body, the pulse, as a general rule, is weak, and there are symptoms of previous or present indigestion. Generally, no unhealthy condition of the organ itself is apparent; though in recent cases the cerumen may be softer and more abundant than usual, and in old standing cases may even be absent.

The *treatment* of cases of debility of the nervous apparatus of the ear arising from bodily debility, consists in imparting, by every possible means, strength to the general system. Exercise in the open air, a due amount of rest and sleep, well-ventilated rooms by day and night, abundance of nutritious food, stimulants in moderation, tonics in the shape of quinine, bark, strychnine, creasote, &c., should be prescribed; while locally, gentle

stimulants should be applied over and around the ear. I have never found the vapour of ether applied to the tympanic cavity by means of the Eustachian catheter of any service; nor has my limited experience of the use of galvanism and electricity hitherto been favourable to their employment. Some cases are decidedly amenable to treatment, and the noises diminish or disappear, while the deafness is greatly diminished; but if the cause in which the deafness originated be allowed to continue, or if any debilitating influence be present, total deafness may ensue in spite of every remedial effort. The following cases are all interesting.

Deafness produced by want of sufficient sleep; cure.—In the early part of 1855, a young gentleman, aged 14, was brought to me by his father, on account of gradually increasing deafness. He appeared to be in tolerable health, and was at school in the neighbourhood of London. No cause could be assigned for the affection, which had so far advanced as to cause him great discomfort from his inability to hear what his masters said to him. On examination, it became apparent that the deafness depended upon debility of the nervous system, for there was no history of any other disease, nor was there any appearance indicative of disease. The patient had, however, occasional noises in the ears following over-exertion, and he certainly was deafer when he was tired. On inquiry, I could discover no special cause for the deafness, as he followed the same rules and regulations which were pursued by all the boys in the school. I prescribed internally quinine, and a stimulating liniment externally, giving directions that he should not be over-worked. In a month's time the boy was seen again, but remained in much the same state, so I requested to be allowed to see the lady with whom he boarded, in order to ascertain further particulars as to his mode of living. On the most minute questioning no sufficient cause could be detected, except that, being very desirous to prepare his lessons well, he sat up so late that when the time arrived for getting up, he was so sleepy as to be roused with difficulty. It was at once rendered probable, that the debility of the nervous apparatus of the ear might be dependent upon the want of sleep; and I therefore requested his friends to see that his duties were so relaxed that he could take as much sleep as he required, and gave directions that he should go to

bed at eight o'clock, and sleep until he awoke of his own accord. The result was, that for several successive nights, he slept for fourteen hours, and by degrees the number was reduced to ten, which was his usual allowance for three weeks, at the end of which time he returned to me, when, to the gratification of all, it was found that his hearing was nearly restored, and he was no longer styled "the deaf boy" at school. This patient has been seen by me twice or thrice since, at considerable intervals, in consequence of the deafness returning; but each time it was evident that the nervous system had been too much exhausted, and the administration of quinine, with less work, and an increase in the amount of sleep, soon restored the hearing.

Total deafness produced by the nervous shock consequent upon successive accouchements.—Mrs. B., aged 40, pale, and of a nervous temperament, consulted me in 1850, on account of complete deafness in both ears. She stated that she had married in India ten years previously, and at the time of her marriage she could hear perfectly well. On the occasion of her first confinement, previous to which her hearing was still perfect, she suffered a good deal from exhaustion, and this was followed by a great degree of deafness, so that she could scarcely hear what was said to her, even when the voice was much raised. Upon getting up, and growing stronger, the deafness was so much relieved that she merely required to be spoken to a little louder than usual. During each successive confinement in India, amounting in all to four, the deafness greatly increased, and after each recovery became more permanent, until, on the last occasion, she remained as deaf as at present, when she is obliged to have recourse to signs. Indeed, she has never heard the voices of her younger children, and can only by the movements of their lips understand their words.

Debility of the nervous apparatus of the ear arising from over-exhaustion in India.—Captain T., aged 40, came home from India in 1858, having undergone great fatigue, and his health having been greatly shattered, while his hearing power had so much diminished, that when he consulted me I was obliged to speak very distinctly within a yard of his head. He complained of constant loud singing in the ears, which was increased by the slightest exertion. On examining the ears, no alteration from the normal condition could be detected, and the Eustachian

tubes were in a natural state. The treatment consisted in sending the patient to the sea-side and in giving him quinine, using at the same time a stimulating liniment over the ears and at the back of the neck. In two months his strength had greatly increased, with a corresponding improvement in the hearing. He returned to the sea-side to pursue the treatment in capital spirits, and was induced to go out on two consecutive days to evening parties, at which he stayed till very late. Nervous exhaustion followed, and his hearing sank to the same low ebb as when he first consulted me: nor was it until after two months of very quiet life and steady keeping to the prescribed treatment, that he again began to improve.

Nervous deafness produced by over-exertion.—E. Clarke, aged 31, a tall muscular carter, was admitted under my care at St. Mary's Hospital, on January 27th, 1859. He stated that fourteen years before, when out of health, deafness came on in the left ear, accompanied by noises, sometimes like a kettle singing, at others, like the ringing of bells. On recovering his health, he found himself perfectly deaf in the left ear, which has remained so ever since. Eleven weeks ago, when a good deal exhausted by hard work, he took a bad cold, during which singing came on in the right ear, with loud noises, like the ringing of bells, and were accompanied with so serious an amount of deafness, that he required to be spoken to in a loud voice, within a yard of his head. The patient's pulse was weak, and he had a worn aspect, as from exhaustion of the nervous system. On examination, no appearance of disease was visible in either ear, and the Eustachian tubes were pervious. Two grains of quinine were ordered to be taken twice daily, and a stimulating liniment to be rubbed over the surface of the ears, at the back of the neck, and down the spine. In the course of a week the noises decreased greatly, and in a fortnight they had wholly disappeared, while the hearing power gradually increased; so that when he left the hospital, at the end of six weeks, to use his own words, he "at times hears quite nicely."

Several cases of a similar character might be cited, in which equally favourable results followed the administration of strychnine, in doses varying from one-thirtieth to one-twentieth of a grain, twice or thrice daily; and in some instances, where neither quinine nor strychnine were of any benefit, doses of

creasote, or of morphia, or of both together, were productive of great improvement.

Nervous deafness relieved by creasote and morphia.—Miss M., aged 29, in good health, but very easily excited, consulted me in January 1859, on account of deafness. Four years previously her left ear gradually became deaf, accompanied with noises very difficult to describe, but something like a whizzing, and these noises were increased by any external noise, or if she felt nervous, tired or excited, and were worse at night. In a few months the right ear was also affected in the same way. In both the deafness was gradually increasing. This deafness was also accompanied by a sudden loss of voice after she had spoken a few words. The only cause to which she can ascribe the deafness was the habit of going for many hours without food, and then eating very rapidly. She had been treated by blisters, whose use had been followed by a rapid advance of the deafness, and she had been told that her case was incurable. At the time of her first consulting me, it was requisite to speak loud within a yard of her head, and she was deaf to all general conversation. On examination, each membrana tympani had a perfectly natural appearance, and the Eustachian tubes were healthy. The *treatment* consisted in using gentle counter-irritation over each ear, the back of the neck, and down the spine, and in administering creasote and morphia, in doses of two or three minims of the former to one-twelfth of a grain of the latter, twice daily. This treatment was continued perseveringly for four months, at the same time that every measure for restoring the general health as respects food, exercise, and diet, were resorted to, and at the end of the treatment the hearing power was so greatly improved that she could both hear and take part in general conversation.

Cases of nervous affection of the ear sometimes occur in which the chief symptom is *pain;* the treatment does not differ from that of the last class of cases.

Pain in the left ear, accompanied by diminished power of hearing, following over-fatigue.—Miss T., aged 25, pale and not strong, was brought to consult me, in May 1856, on account of a pain in the left ear; this pain had made its first appearance about a year before, after the patient had undergone considerable fatigue by attending several evening parties in

succession, and remaining very late; and the pain was much accelerated by any cause which produced fatigue. The hearing power was very slightly affected; and as the other ear was perfect, no complaint was made respecting the hearing. On examination, the organ appeared to be quite healthy; and feeling that the pain arose from deranged action of the nerve consequent upon debility, quinine was prescribed internally, and mild stimulants applied over the ear and down the spine. This treatment was followed by considerable success, as the pain disappeared in the course of a month, but returned slightly upon the patient having to undergo great fatigue.

CHAPTER XVI.

THE DISEASES OF THE NERVOUS APPARATUS (*concluded*).

ULCERATION OF THE MEMBRANOUS LABYRINTH—CARIES AND NECROSIS OF THE PETROUS BONE.

In the cases hitherto described of disease extending from the tympanic cavity to the brain, the upper osseous wall of the tympanum was the part affected, and the medium through which disease advanced to the middle cerebral cavity. There is, however, another medium by which disease may be conveyed from the tympanic cavity to the brain; and that is through the labyrinth. When it is remembered that at the inner wall of the tympanum a delicate membrane (membrana fenestræ rotundæ) is all that separates it from the cochlea, and that the base of the stapes with its fine ligaments form the only septum between that wall and the vestibule, it will naturally be inferred that disease in the tympanic cavity would frequently advance to the labyrinth. The occurrence is, however, in fact, very rare, for this reason, that ulceration of the mucous membrane of the tympanum is far from a common disease, while, under the influence of chronic inflammation and of the secretion collected in the tympanum, the membranes both of the fenestra rotunda and ovalis become thickened and turgid.

I am not aware that any case has been recorded in which disease had made its way through the fenestra rotunda to the labyrinth; but in the course of my dissections I have found the medium of communication to have been, in one instance, the fenestra ovalis, and, in the other, a carious aperture in the outer arm of the external semicircular canal, where it bulges into the tympanic cavity, and is covered by the tympanic mucous membrane. When suppuration takes place in the labyrinth, the disease readily advances through the cribriform floor of the meatus auditorius internus to the auditory nerve, and thence to

the base of the brain and medulla oblongata. In certain cases purulent matter is effused beneath the arachnoid over the whole surface of the base of the brain, surrounding the nerves in their cranial course; and the substance of the pons Varolii or medulla oblongata may be destroyed by ulceration, or an abscess may form between the arachnoid and pia mater. In some cases the disease extends a considerable distance down the medulla spinalis.

In some cases the labyrinth becomes carious or necrosed, and the dead bone is discharged without the production of any symptoms of cerebral disturbance, as in the following cases. The first occurred to my friend Mr. Hinton, who kindly placed the preparation in my museum. It was of a man æt. 55, who suffered from a discharge from the right ear for some years, and at last the cochlea was discharged entire. The second case occurred to Mr. Shaw, and the following report is extracted from the seventh volume of the *Transactions of the Pathological Society of London* :—

Extraction from the left ear of a boy of the greater part of the petrosal portion of the temporal bone, including the meatus auditorius internus and labyrinth, separated by necrosis.

"A boy from the country, æt. 7, was admitted into the Middlesex Hospital on the 31st of July, 1855, under Mr. Shaw, for otorrhœa affecting both ears. The disease succeeded a severe attack of scarlet fever, which he had two years and a half ago. From the right ear the discharge of pus was not of great amount. The left external ear projected considerably beyond its proper level, and an irregular piece of bone, surrounded with fungous granulations, protruded from the meatus into the concha. He had paralysis of the muscles of the left side of the face; for a year he had been completely deaf in both ears.

"On the 3rd of August, he was put under the influence of chloroform, when Mr. Shaw first extracted the piece of bone which projected into the concha; this appeared to have been the posterior border of the external meatus of the temporal bone.

"The cartilaginous tube having been ulcerated by the pressure of the loose fragment, the point of the little finger could now be passed inwards to some depth; when another larger piece of bone was felt rolling freely in the cavity. This was seized by

the dressing forceps; and after it had slipped once or twice, owing to its hardness and smoothness, it was extracted by employing force and a twisting motion, so as to favour its coming in a proper direction. For a few seconds after the removal dark venous blood flowed rather freely. As a precaution, he was kept in bed for a week; by degrees the discharge lessened, and the ulcer of the tube cicatrised. No untoward symptoms arose; and in the end of September, except from the paralysis of the face, the deafness, and a trifling discharge from both ears, he left the hospital in good health."

Description of the specimen.—The density of structure, weight, and shape of the portion of bone last removed, at once showed that it formed nearly the whole of the petrous portion of the temporal bone. It was of irregular cylindrical, or rhomboidal figure; it measured one inch in length; its average thickness in various directions was half an inch; it weighed twenty-two grains. On one side, nearly in its centre, was an opening and cavity with well-defined borders and walls, which was recognised to be the meatus auditorius internus. The depth of the meatus, from the margin to the thin perforated plate through which the auditory nerve penetrates into the labyrinth, was three-fifths of an inch; and as that is the full depth of the cavity in its normal state, it was thereby shown that the whole of the internal meatus was included in the specimen. At the bottom of the meatus could be seen the commencement of the canal for the portio dura. On the side of the specimen in relation with the brain, the surface presented the cancellated appearance peculiar to the diplöe; whence it was concluded that, in the detaching of the necrosed part, the process of separation had taken place in the diplöe—that the cortical layer had retained its vitality, and, remaining in contact with the dura mater, had served as a barrier to prevent disease from extending to the cerebrum. On turning the bone round to view it in its opposite aspect, the side then exposed was seen to be the internal wall or boundary of the tympanic cavity; it was easy to distinguish the "promontory," having above it the "fenestra ovalis," and below it the "fenestra rotunda;" the two latter openings were broken and irregular, and through the enlarged holes thus produced the interior of the "vestibule," with its fossæ, the cochlea, modiolus, and lamina spiralis, somewhat

injured, were seen. At the posterior part of the specimen portions of the semicircular canals, broken off near their junction with the vestibule, stood up distinctly into view.

In other instances, although the brain is seriously implicated, the patients recover, as in the following case quoted from Mr. Wilde. He says: "I am indebted to Sir Philip Crampton for an examination of one of the most extraordinary pathological dissections of diseased bones perhaps in existence, consisting of the entire internal ear, cochlea, vestibulum, and semicircular canals, with a small portion of the inner wall of the tympanum, which he drew forth from the meatus of a young lady who, after the most urgent symptoms of inflammation of the brain, with paralysis of the face, arm, and leg, and total deafness of one side, recovered from the bad symptoms and the paralysis of the extremities after a copious discharge from the ear. This discharge, the paralysis of the face, and deafness, continued some time, accompanied by occasional attacks of pain in the ear, till one day Sir Philip, perceiving a portion of loose bone lying deep in the cavity of the meatus, drew forth the specimen from which the illustration in the volume was made. It does not appear that the hard external enamel of the bone was affected, but the scala cochleæ is far more beautifully displayed than could possibly have been done by art."

In the following case, which, on several grounds, is one of great interest, the disease advanced through a carious orifice in the semicircular canal to the labyrinth.

Disease in the tympanic cavity, extending through a carious orifice in one of the semicircular canals to the labyrinth, and thence by the auditory and facial nerves to the brain.—On the 28th of March, 1851, I was called in by Mr. Such, of Dalby-terrace, City-road, at the request of Mr. Coulson, who had also seen the patient, to see a German gentleman, aged 26, the history of whose case I found to be as follows:—He was of a robust constitution, and had generally enjoyed the best of health: indeed, even when first seen by me, he had the appearance of a stout healthy man. Between four and five years previously, he complained of occasional pain in the right ear, which was usually followed by a discharge that by degrees became constant. Three weeks before my seeing him, he suffered from a severe attack of pain in the head, which ceased on

the occurrence of an increased quantity of discharge. Nothing particular happened further until ten days previous to my visit (excepting a sleepless state at night), when he was suddenly seized with a violent pain in the head, which the ordinary remedies failed to relieve; and by degrees this pain extended to the back of the neck, and as low as the sixth dorsal vertebra. About the same time there was paralysis of the right facial nerve. For several days there had been a continual shivering fit about two o'clock P.M. On the evening of the 28th, at which time I saw him, he was suffering from great pain at the back of the neck; was very restless, particularly at times, but talked quite sensibly; the right facial nerve was paralysed; he squinted, and the pulse was 85. The external meatus was nearly filled by a polypus: the discharge was very fetid and abundant. A large blister was ordered to be applied to the nape of the neck; the ear to be frequently syringed with hot water; and, as the patient was very sensitive to the action of mercury, a quarter of a grain of grey powder, with three grains of extract of henbane, were administered every two hours.

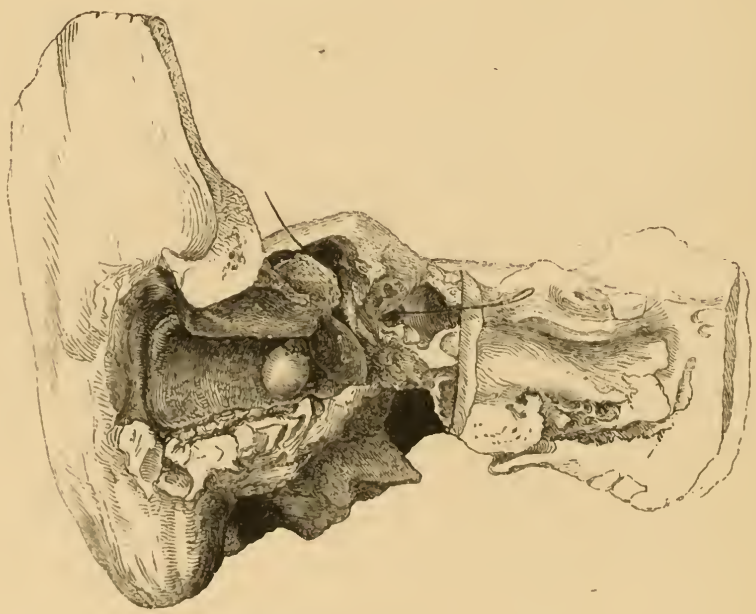
March 29th, 9 P.M.—The mercury has already caused great tenderness of the gums. The symptoms have materially increased; the pain at the back of the head was very violent this morning, the squinting continues, and he sees double. At three o'clock to-day he became insensible, but was roused by a loud noise, and spoke rationally for a minute or two, but then relapsed into a state of incoherency. Pulse as yesterday; respiration oppressed and low; face and head congested and blue; discharge from the ear abundant and fetid. Leeches were applied below the ear.

March 30th.—Slight relief followed the application of the leeches, but the patient soon grew rapidly worse. The right side of the body became paralysed, the breathing stertorous, and the face livid. Insensibility gradually came on, and he died at 6 P.M.

Autopsy, twelve hours after death.—With the exception of a large quantity of chocolate-coloured fluid in the lateral ventricles, the cerebrum was healthy, as was also the cerebellum. The arachnoidal surface of the dura mater, covering the superior and mastoid surfaces of the petrous bone, was in a healthy state; but upon removing it from the bone, over two small portions of

both surfaces, it was found to be softer than natural, and these soft portions covered apertures in the diseased bone. The appearance of disease was, however, so slight, that it was quite manifest that the affection of the ear had not made its way inwards at either of the two points. On removing the brain, there was evidence of very extensive disease at its base. Purulent matter was deposited beneath the arachnoid, from the roots of the olfactory bulbs, anteriorly, to the medulla oblongata, posteriorly. In some parts this pus was of a dark colour; in others, as in the pons Varolii, the arachnoid membrane was ulcerated. The principal seat of the disease was the right side of the pons Varolii, the substance of which was ulcerated to the depth of a line to a line and a half, over a surface as large as a sixpence. All the nerves, at their origins, were surrounded with pus, and the substance of the facial and auditory nerves of the right side was so soft as to be scarcely distinguishable from purulent matter. On examining the petrous bone, the dura mater around the orifice of the meatus auditorius internus was observed to be softened and detached from the denuded bone. The portions of the auditory and facial nerves within the meatus were also in a state of suppuration. The whole of the petrous bone being removed for the purpose of careful dissection, the following was the condition of the parts detected. The external meatus contained two polypi, one of which, as large as a small pea, was attached, by a broad base, to the posterior wall of the meatus, about its middle; the other, and smaller, about the size of a grape seed, was also attached to the meatus near the former. When the membranous meatus was separated from the bone, there was found in the latter an orifice between two and three lines in diameter, so that a communication existed between the meatus and the mastoid cells; there was, however, no orifice in the membranous meatus, and consequently the discharge from the ear came not from the mastoid cells, but from the surface of the meatus only. The membrana tympani was entire, but quite white and much thicker than natural. The tympanic cavity contained a large quantity of fetid pus, and its lining fibro-mucous membrane was ulcerated at several points. Within the cavity there were also two portions of carious bone, one projecting towards the cavity of the cerebrum and in contact with the outer surface of the dura mater; the other, looking

towards the cavity of the cerebellum and also in contact with the dura mater, which membrane, as before stated, was, at the points referred to, thick and soft. The ossicles were present, and the stapes adhered with its usual degree of firmness to the circumference of the fenestra ovalis. On laying open the cavity of the vestibule, it was found to be full of a dark-coloured pus, having a fetid odour; the semicircular canals were also full of similar matter, and the osseous wall of the superior canal was carious at two or three points. This purulent matter extended from the vestibule and cochlea to the meatus auditorius internus. While carefully examining the external semicircular canal, where it makes a bulging in the tympanic cavity, a small carious aperture, not larger than a small pin's head, was detected in it, which contained fetid pus, and was the only medium through which disease could have been transmitted from the tympanic cavity to the vestibule.



CARIES OF THE EXTERNAL SEMICIRCULAR CANAL. A BRISTLE IS PLACED THROUGH THE APERTURE IN THE SEMICIRCULAR CANAL, SHOWING THE COMMUNICATION BETWEEN THE VESTIBULE AND THE TYMPANIC CAVITY; THE UPPER WALL OF THE TYMPANUM HAS BEEN CUT AWAY.

I have described this case as one of disease originating in the tympanic cavity, and extending thence to the vestibule, inwards, and to the meatus, outwards. The grounds for my belief that the disease originated in the tympanic cavity are

various. In the first place, it is very rare for suppuration to originate in the labyrinth, nor do I recollect ever to have met with a well-marked case of the kind: and had it, in this instance, originated in the labyrinth, it would most probably have produced death before it reached the tympanum. In the second place, the tympanum is, as has been stated, a frequent seat of disease; and the presence of the undetached portions of necrosed bone indicates long-standing disease.

The nature and progress of the disease would appear to have been the following:—When it first made its appearance, it was probably one of catarrh of the mucous membrane; the quantity of mucus secreted was too large to admit of its entire escape through the Eustachian tube; the membrana tympani was consequently pressed upon, and, instead of ulcerating and allowing the matter to escape externally, became itself much thickened and very rigid; the secretion being thus confined in the tympanic cavity, produced caries of the bone and penetrated the labyrinth. There can, it seems to me, be no doubt, that had the membrana tympani been partially destroyed, and free egress been in that way afforded to the secreted matter, the disease in the bone might have been prevented, and the life of the patient by that means saved.

Another opportunity was kindly given to me, by the late Mr. Avery, of seeing the post-mortem, and making a careful dissection of the ear, in a second case of disease advancing from the tympanum to the labyrinth. In this instance, the medium of communication was the fenestra ovalis, which had been left open after the removal of the stapes by ulceration.

Ulceration of the tympanic mucous membrane: extension of disease to the labyrinth through the fenestra ovalis.—James Warner Smith, aged 17, a sailor, was admitted into the Charing Cross Hospital, on the 14th of January, 1846. The history of his case was, that at five years of age he had an attack of measles, followed by an abundant discharge from the left ear, from which he has never since been perfectly free, although occasionally the quantity was very small. He had usually enjoyed good health. Three months previously, when off the Cape of Good Hope, he was up aloft during a gale, and lost his cap. Great pain in the ear followed this accident, and the quantity of discharge increased. There have been many attacks

of pain since, and occasionally a sanguineous discharge. When he came on shore, he took a fresh cold, and the pain in the head and ear became very violent. He now consulted a surgeon, who ordered him injections, drops, and ointments; but not obtaining any relief, he applied to Charing Cross Hospital. At the time of his admission, he complained of constant pain in the left ear, and in the left side of the head as high as the vertex, with a certain degree of pain also on the right side. The muscles on the right side of the face were constantly twitching, and the mouth was as constantly drawn to that side. Some intolerance of light was also observed. An abundant offensive discharge proceeded from the left ear: but there was no tenderness over the mastoid process.

January 16th.—Has had a violent paroxysm of pain in the night, but is better this morning, and the twitching has subsided, except in the right eyelid. Calomel and opium were administered.

January 22nd.—Much better; slept well; pain abated.

January 24th.—Pain returned as violently as ever.

January 27th.—Delirious during the whole of the day.

January 29th.—Delirium continues: complains of intense pain in both sides of the head; discharge from the ear abundant; head drawn backwards.

January 30th.—The delirium has left him, but he is exceedingly drowsy, and is roused with great difficulty. The movements of the limbs and their sensation unaffected. The pupils acted properly.

February 1st.—The drowsiness has vanished; has had no delirium; and has passed a good night; but still complains of considerable pain in the ear and over the eyes. He remained in this state until the 5th, when he gradually sank, without coma or cerebral symptoms of any marked character. The retraction of the head continued to the last. He was quite sensible before he died.

Autopsy, thirty-six hours after death.—On removing the dura mater, the surface of the arachnoid was observed to be remarkably dry; the vessels of the pia mater were more than usually injected on the convex surface of the hemispheres; there were two or three small yellow patches beneath the arachnoid. Each lateral ventricle contained at least three ounces of clear fluid;

in the posterior corner of the right, and in the inferior of the left, were two patches of bright yellow lymph, as large as half-a-crown, which were covered by a thick creamy purulent fluid. The third ventricle contained a dark clot of blood, of the size of a small walnut, which could be traced into the fourth ventricle, where there was also a small coagulum. The commissura mollis was broken down. Surrounding the lower part of the commissure of the optic nerves, and covering the pons Varolii, crura cerebri, medulla oblongata, and upper part of the medulla spinalis, was a layer of pure yellow pus and lymph, nearly half an inch thick; it embraced the nerves at the base of the brain to their passage through their several foramina. The parts in direct contact with this layer were very soft. Under the pia mater, where the right anterior lobe rests on the orbital plate of the frontal bone, there was a patch of effused blood, the size of a shilling. The dura mater covering each petrous bone was healthy, and the exterior of the bone did not present any appearance of disease. On examining the cavity of the ear, the membrana tympani was found to have been destroyed by ulceration, and all the ossicles had disappeared. The tympanic cavity was full of the most offensive secretion, and its lining membrane was ulcerated. The fenestra ovalis was open, and, in the cavity of the vestibule, similar matter was found to that in the tympanum. The whole of the natural membranous labyrinth had been destroyed. The auditory nerve was tumefied, and of a dull livid colour, the disease having evidently advanced to it through the cribriform floor of the internal auditory meatus, and thence to the base of the brain.

It is to be remarked, that in this case there appeared to be no obstacle to the free egress of the matter, except the accumulation of thick masses of it in the cavity of the tympanum. It is far from improbable that, in cases of ulceration of the mucous membrane of the tympanum and loss of the stapes, the thick secretion in the tympanum may be quite sufficient to cause the disease to advance inwards. The case is also another illustration of the necessity there exists for frequently washing out the tympanic cavity with warm water. It is, however, no doubt possible, ere the stapes is removed, for the disease to advance to the vestibule without the agency of the pent-up matter in the tympanum.

Besides the two cases just described, I have met with two others; and as these four cases are the only instances I have found on record of this peculiar form of the disease, brief particulars of the two latter are subjoined.

The first of these cases occurred in the practice of Mr. Streeter, and was laid by him before the Westminster Medical Society on the 13th January, 1844.

Disease extending from the tympanic cavity to the labyrinth, and thence to the medulla oblongata and the base of the brain.—The patient was a lady, aged 42, who had been deaf in the right ear since the age of seven, but from what cause was not known. Two or three months previous to her death, she became affected with a severe headache, for which a blister was applied at the back of the neck. Nothing serious, however, was thought of the matter until the 17th December, when the severity of the pain so increased as to become of a maddening character, and almost to produce delirium. The right portio dura nerve was paralysed, and there was severe pain down the spine, which was attributed to a fall received when getting out of bed. The pulse did not warrant active depletion, but two or three leeches were applied behind the affected ear; a large poultice was applied over the face; the ear was gently syringed with warm water, and saline medicines were ordered. On the 18th she had some sleep in the night, but complained of an almost intolerable pain in the back. The catamenia now appeared, and the cause of the pain remained obscure. She was quite sensible, the pupils acted, but the cornea on the affected side had begun to ulcerate. There was a slight discharge from the right ear, and the left had become somewhat deaf. It was thought that a hole could be observed in the membrana tympani: calomel and opium were administered.

December 19th.—She has slept better and remained somewhat improved until five or six in the evening of the 21st, when she was suddenly seized with coma, and continued in that state until the following morning, when she died.

Autopsy.—On examining the brain, slight sub-arachnoid effusion and vascularity of its surface were found, as also some increase of vascularity in the interior; but there was no effusion in the ventricles. An abscess was discovered in the tympanum and labyrinth, and there was a counter-abscess, about the size of

a large pea, in the condensed arachnoid and pia mater, occupying the fossa where the facial and auditory nerves proceed, from the junction of the medulla oblongata with the pons Varolii and cerebellum. Pus was effused beneath the arachnoid and pia mater, investing the right side of the upper portion of the medulla oblongata, and the adjoining part of the right lobe of the cerebellum, to about the extent of a square inch ; but there was neither softening nor apparent lesion of the proper cerebral tissue beneath.

The exact condition of the tympanic cavity and labyrinth is not detailed in the above notes by Mr. Streeter ; but there can be no doubt that the disease (most probably ulceration of the mucous membrane) had extended from the tympanum to the vestibule, either through the fenestra rotunda or ovalis, or by means of an orifice in the osseous wall of the labyrinth. The state of the portio dura and portio mollis nerves is not stated ; but judging from the records of other cases of a similar character to the present, these nerves must have undergone some morbid change and communicated the disease to the base of the brain.

The remaining case is taken from M. Itard's work,* and is as follows :—A man, aged 22, five weeks before his death, complained of tooth-ache : this was followed by febrile symptoms. On the twelfth day after the attack, discharge took place from the left ear, but symptoms of cerebral irritation increased until his death.

Autopsy.—Over the convex surface of the brain, and in its substance, were a number of small purulent deposits. The cerebellum was similarly affected, but in a less degree. The auditory and facial nerves were in a state of suppuration, and almost wholly destroyed : pus was also found in the internal auditory meatus, the vestibule, cochlea, and semicircular canals, and the tympanic cavity.

The treatment to be pursued in these cases is similar to that recommended in cases of disease of the tympanum and the mastoid cells.

* Traité des Maladies de l'Oreille, 1821. Tome i. p. 254, Obs. 22.

CHAPTER XVII.

MALIGNANT DISEASE OF THE EAR.

ORIGIN IN THE MUCOUS MEMBRANE OF THE TYMPANUM — DESTRUCTION OF THE PETROUS BONE—SOMETIMES MISTAKEN FOR POLYPUS—OPERATIONS TO BE AVOIDED—BRAIN AND DURA MATER INVOLVED—TREATMENT.

Cases of malignant disease, advancing from the ear towards the brain, appear to be of rare occurrence. So far as my own experience and the aid of published cases permit me to judge, it appears most probable that the part of the ear in which malignant disease usually originates, is the mucous membrane lining the cavity of the tympanum. After the diseased growth has destroyed the membrana tympani, it advances through the external meatus to the outer orifice, where it shows itself in the shape of a small tumour, which has sometimes been mistaken for a polypus, and the removal of which has caused hæmorrhage and an aggravation of the symptoms. At the same time that the disease advances outwards, it also encroaches upon the whole of the parts surrounding the organ of hearing. The osseous walls of the meatus externus and of the tympanic cavity are wholly destroyed; the outer part, and even the whole of the petrous bone, are converted into a mass of disease; the lower part of the squamous bone also disappears, and the tumour advances into the cavity of the skull, where it destroys life, either by its pressure upon the brain or its blood-vessels, or by involving the brain itself in the disease.

This malignant disease is sometimes of the nature of fungus hæmatodes; at other times it has the characters of encephaloid disease. This affection occurs at various periods of life: the ages of the three patients to whose cases reference is about to be made, were respectively 3, 18, and 35; the progress is very rapid generally, and forms a marked contrast with those cases of chronic disease of the ear advancing to the brain, to which attention has hitherto been drawn.

Sophia W., aged 35, a single woman, was admitted under my care into St. Mary's Hospital, on the 14th July, 1854. The history, as given by herself, is, that after a severe cold, a year previously, the right ear suddenly became painful, though the pain was not very severe. Since the above period, the pain has been gradually increasing, accompanied by a tumefaction of the right side of the face. Six months ago a red growth was removed from the tube of the ear, which the surgeon considered to be a polypus, and since then she has had at times a good deal of bleeding from the ear. Lately the pain has greatly increased, and has extended over the side of the head and the face; a small round swelling has also appeared at the orifice of the ear. On examination, the external ear was observed to be much redder than natural, and somewhat hypertrophied; and the orifice of the meatus was closed by a red tumour, about the size of an almond, upon pressing one side of which a small quantity of sanious discharge issued from the meatus. The integuments around the ear, for the distance of an inch and a half, were red, soft, and somewhat elevated above the surrounding parts by a tumour beneath them. The left portio dura nerve was completely paralysed; there was much pain of a pricking and shooting character complained of in the region of the tumour, and this at times extended inwards to the brain. The treatment consisted in occasionally applying a leech or two in the region of the ear, so as by diminishing the congestion, to relieve the pain; small doses of morphia were frequently administered, and the general health supported; the meatus was frequently syringed with warm water, and emollient applications made to the tumour. These remedies, however, led to very transient amelioration of the symptoms; though the pain would sometimes subside, the patient was subject to frequent and severe relapses. She was able, however, to walk about the ward, and a few days previous to her death expressed a wish to leave the hospital in order to visit her friends in the country. On the 23rd of October, she did not complain more than usual of the pain in the face and head, but on the 24th and 25th there were symptoms of considerable cerebral congestion, she wandered a good deal, and the head was evidently a source of great distress to her. The symptoms of congestion gradually increased, and she died on the 28th of October.

Autopsy.—The integuments of the external ear, and those covering the tumour, were red and tumefied. Upon reflecting the ear and the integuments from the tumour, a large mass was exposed, which extended from the posterior part of the mastoid process, posteriorly, to the body of the malar bone anteriorly, and also from half an inch below the squamous suture to the angle of the inferior maxilla below. The tumour was intimately connected with the integuments, and of a reddish white colour. It presented different degrees of consistence, being in front, where it surrounded the ascending ramus of the lower maxilla, quite hard and firm like the pancreas, while more posteriorly it was softer; and deeper towards the styloid process, there was a large quantity of a white creamy fluid. Both anterior and posterior to the external auditory meatus, the tumour contained small spiculæ of bone. The mastoid process was involved in the disease, and was reduced to some detached masses of bone in the middle of a portion of the tumour. The osseous meatus had wholly disappeared, and the remains of the membranous meatus could scarcely be distinguished, its walls having become so much involved in the diseased mass. The only remains of the tympanic cavity were some portions of the mucous membrane, having a dark livid hue, with distended blood-vessels, and small red growths attached to it. Not a remnant was left of the bony cavity. The whole of the squamous bone, from an inch below the squamous suture, and the whole of the outer part of the petrous bone, had been destroyed, so that the apex of the petrous bone had no connexion with the squamous. The tumour had advanced inwards to the cavities of the cerebrum and cerebellum, through the aperture formed by the destruction of the squamous and petrous bones. In the middle cerebral fossa was a reddish white tumour, of about the size of a small pear, which consisted of two portions, one below, and the other above, the dura mater. The part below the dura mater was directly continuous with the external tumour, while the large portion above seemed to be an independent growth from the free surface of the dura mater, and connected to the larger mass of the tumour by blood-vessels only. The upper part of this portion of the tumour was adherent to the lower surface of the left middle cerebral lobe, which was softened to the depth of half an inch. The part of the tumour posterior to the petrous bone, and

beneath the tentorium, was somewhat smaller and less prominent than that just described in the middle cerebral fossa, was wholly confined to the interior surface of the dura mater, and must have almost entirely arrested the circulation in the lateral sinus. The whole of the cerebral veins and sinuses were very much distended with dark-coloured blood, but there was no appearance of disease in any other part of the cerebral substance than the softened portion of the inferior lobe.

On examining the tumour by the aid of the microscope, the harder portions were found to consist of very delicate fibres and nucleated cells, while the softer parts and creamy fluid were almost wholly composed of nucleated cells, circular, fusiform, and angular.

There appears every reason to believe that, in this case, the disease originated in the tympanic cavity. It will have been seen that the seat of the pain, when first complained of, was the ear. This was followed by a growth from the meatus, similar to a polypus, and then by paralysis of the portio dura nerve. From this centre the disease seems to have spread in all directions, destroying every structure which it approached. In the preparation, a large portion of the osseous wall of the cranium is seen to be absent, so that, by pressing upon the tumour during life, the contents of the cerebral cavity were also subject to pressure. Unfortunately in these cases, little can be done even to alleviate the sufferings of the patient. Local depletion by leeches applied to the vicinity of the tumour, hot fomentations and the administration of opiates, appear to be the only remedies capable of doing any service. It is nevertheless of the utmost importance to be able to decide upon the nature of the disease whenever it does occur, since measures will at least be refrained from that are calculated to aggravate the disease, and no operation will be attempted. In the case in question, it is possible that the removal of part of the tumour, which was thought to be a polypus, did material injury, by causing the disease to advance more rapidly. Those who are careful will have no difficulty in distinguishing between an ordinary polypus growing from the walls of the meatus, and a portion of tumour similar to that of the case under discussion. The polypus is smooth and globular, and not covered by epidermis; neither does it present an ulcerated surface, such as would be disclosed by a portion of encephaloid tumour when

it exists and gives off secretion. Again, in cases of polypus growing from the external meatus, there is very rarely any tumefaction of the ear or integuments, such as is found in malignant disease. The observation, so frequently made by me, may here be repeated, that as polypoid growths are so often symptomatic of the existence of irritation within the tympanic cavity, and are sometimes co-existent with disease of the bone, great caution should always be used previous to proceeding to extirpation. By referring to a very interesting case of malignant disease of the ear, published by Mr. Wilde at page 206 of his treatise on Aural Surgery, it will be found that he also lays much stress upon the necessity of being careful "in meddling with morbid growths of long standing, without being fully satisfied as to their nature, and the place from which they grow." The cause of death in the patient whose case has here been considered, appears to have been congestion of the brain, produced by the pressure of the tumour on its substance, as well as upon the lateral sinus.

The second preparation illustrative of the effects of malignant disease of the ear extending to the brain, which has to be described, was laid before the Pathological Society of London, in 1850, by Mr. Cooper Forster, to whom I am indebted for the specimen. The particulars, copied from the *Transactions of the Pathological Society*, are as follow :—

"A strumous lad, aged 19, was knocked down by a cab nineteen months before his death, and struck on the right side of his head. He soon afterwards became deaf, and suffered severe pain in the right ear; the part became slightly swollen and excessively tender, especially over the mastoid process. The swelling did not increase, but the pain in the head was most intense, and paralysis of the right portio dura nerve took place. No great change occurred until within the last six months, when, from another blow on the same spot, the disease seemed to become more active; the side of the head, from above the temporal ridge to two inches below the ear, became enormously enlarged and tender; and the external ear appeared as though pushed away from the side of the head. He experienced great difficulty in swallowing solid food, and was also unable to speak.

"About two months before his death, the swelling began to fungate and slough, profuse hæmorrhage occurred at intervals,

and sloughing very rapidly took place, and at last laid bare the pharynx. To such an extent, ultimately, had the destructive action taken place, that a large chasm formed around the ear, leaving that organ completely isolated. No brain symptoms occurred. The profuse hæmorrhage and constant drain of pus quickly destroyed him.

"*Autopsy.*—The brain appeared perfectly healthy except at the lower part of the right hemisphere, which was pulpy and very soft. The softening was, without doubt, occasioned by the upward pressure of a hard scrofulous-looking mass, attached to the petrous portion of the temporal bone, through the intervention of the dura mater, from which it seemed to spring. The mass pressed upon the bone below, and appeared as though inclined to force its way downwards, through the temporal bone, at the junction of the squamous with the petrous portion, a great part of the latter being completely absorbed. Some new bone had formed at the inner side, and the whole of the exterior was occupied by a sloughy mass and carious bone (as seen below), the surrounding parts being very hypertrophied; no vestige of meatus or mastoid cells could be discovered: the lateral sinus was filled by a coagulum."

From the history of the case just cited, and an examination

of the preparation, there is no doubt on my mind but that the nature of the disease was malignant, very probably encephaloid, and that it commenced in the tympanic cavity. It will have been observed, that the early symptoms indicated that the disease was in the ear, both by the pain experienced there, and by the presence of deafness. If the preparation be carefully inspected, it will be seen that the largest amount of destruction, and the most marked appearance of disease, are around the tympanic cavity; from which the progress seems to have been downwards to the pharynx, upwards to the outer surface of the squamous bone, and lastly, inwards and upwards to the cavity of the skull. The orifice communicating between the disease without and that within, is, however, very small in comparison to the extent of the disease externally, and the internal surface of the bone is much less affected than the outer. That the disease was malignant is shown, I think, by the bleeding and fungoid character of the soft growth, and the peculiar expanded and spiculated state of the bone.

The third case is one published in the eleventh volume of the *Edinburgh Medical and Surgical Journal*, by Mr. Wishart, and called by him a case of fungus hæmatodes. The subject was a child three years old, in whom, after suffering for some weeks from severe pain in the right ear, followed by discharge, a tumour appeared surrounding the ear, and which speedily ulcerated, discharging a large quantity of fetid bloody matter; hæmorrhage also frequently occurred. The child died within fifteen weeks after the appearance of the disease. On a post-mortem examination, the tumour was found to be as large as the child's head; externally it had caused the destruction of the condyloid process of the lower jaw; the zygomatic process was also gone. The tumour had advanced inwards, destroying the whole of the petrous bone, and extended upwards, through a large orifice in the squamous bone, so as to form a depression on the middle lobe of the brain, which was in other respects quite sound.

As bearing upon the subject, I may as well give briefly the particulars of a case of disease of the petrous bone which occurred in the practice of Mr. Part of Camden Town, to whom I am indebted for the preparation. The patient was a clergyman, aged twenty-five, subject for five years to a dis-

charge from the right ear, with occasional pain. A year before his death an abscess broke behind the ear, which discharged at times. About a fortnight before his death he suffered from severe pain in the head and vomiting, and had paralysis of the right portio dura nerve. He was not relieved by any treatment, and the head symptoms increased until his death. On a post-mortem inspection, a cavity was found in front of the ear, and another beneath the temporal muscles; both contained a soft caseous substance. The whole of the petrous bone, a portion of the basilar process of the occipital and of the sphenoid, were found degenerated into a soft cheesy mass. The malar bone was destroyed, and the mastoid process occupied by the disease. The ventricles contained three ounces of bloody serum; the arachnoid was much injected; while between it and the pia mater was a layer of very yellow pus, extending along the base of the brain. In the middle lobe of the brain was an abscess containing upwards of an ounce of very fetid greenish pus; and a second abscess existed in the middle of the posterior lobe. If the preparation be examined, as in the preceding cases, there will be found to be a large aperture in the squamous bone, and the petrous and mastoid bones are wholly converted into the white cheesy-looking matter. On examination by the microscope, this matter is discovered to consist of cells, varying in form, only few of which have any distinct nuclei; granular matter is also interspersed among the cells. The case may be considered as one of degeneration of the petrous bone, originating in the tympanic cavity.

The ulceration at times proceeds most rapidly, extending to the bone, which is soon destroyed. Sometimes the greater part of the squamous bone disappears. A case of the kind has been published by Dr. Russell of Birmingham, in the *Association Journal*, for March 31st, 1852, of which I will give a few particulars.

Mrs. P., aged 66, was attacked, about nine months before her decease, with pain in the right ear, attended with swelling. A fortnight afterwards, she struck it against a bracket; the swelling broke, and the ear discharged. The discharge and pain continued, and paralysis of the portio dura ensued, while the power of hearing disappeared. At the time she was seen by Dr. Russell, there was intense pain in the ear; mania, coma,

and ultimately death, ensued. There was no history of early disease in the ear, but she had been accustomed to pick it with a pin, for a certain degree of itching. On an *autopsy*, the entire squamous portion of the temporal bone was found to have been destroyed, and the disease had encroached upon the mastoid process, laying open the cells. The petrous bone was also almost entirely destroyed. The dura mater was not injured, except in one spot, where there was a sloughy opening, the size of a crown-piece. Opposite the orifice in the dura mater, the brain was in a state of suppuration; and both ventricles were full of the débris of sloughy cerebral tissue. There were about two drachms of thin, purulent fluid at the base of the brain. This specimen, which through the kindness of Dr. Russell I had an opportunity of inspecting, presented a very similar appearance to the one previously described. In each case all vestiges of the tympanic cavity had disappeared. They differ from the great majority of cases of disease in the tympanum in extending outwards instead of upwards.

The *treatment* in these cases consists in diminishing the symptoms of congestion of the brain, by the occasional application of leeches, and in attempting to allay the pain by the administration of morphia.

CHAPTER XVIII.

ON THE DEAF AND DUMB.

DISEASES PRODUCING DEAF-MUTISM—THE CONDITION OF THE EARS IN THE DEAF AND DUMB, AS ASCERTAINED BY EXAMINATION DURING LIFE—THE CONDITION OF THE EAR IN THE DEAF AND DUMB, AS REVEALED BY DISSECTION—THE MODE OF EXAMINING A CHILD SUPPOSED TO BE DEAF AND DUMB—ON THE MEDICAL TREATMENT OF THE EARS OF THE DEAF AND DUMB—THE AMOUNT OF HEARING POSSESSED BY CHILDREN USUALLY ACCOUNTED DEAF AND DUMB—ON THE EDUCATION OF THE DEAF AND DUMB; WITH CASES.

THE number of deaf-mute children examined, and from whom the facts in this chapter were obtained, amounted to 411. Of these, 313 were congenital cases, and 98 were the effect of different diseases acquired subsequent to birth.

I. THE DISEASES PRODUCING DEAF-MUTISM.

On the causes producing congenital deaf-mutism I am unable to offer a decided opinion; but the results of dissection, as detailed in a subsequent part of this chapter, show that the nervous apparatus is very frequently affected. If regard be also paid to the other cases I shall refer to, and the non-appearance of an efficient cause of any other kind, together with the analogy to be drawn from the cases in the chapter on Nervous Deafness, it would be no very violent assumption to suppose that early derangement of the nervous apparatus is at the root of most of the instances of deaf-mutism.

Of the causes of *acquired* deaf-mutism a more accurate estimate may be formed. Thus in the 98 cases of acquired deafness the causes were as follows:—

Scarlet fever	36
Fever	23
Measles	4
Various diseases, as teething, convulsions, hydrocephalus, a fall, fits, a fright, &c. . .	35
	98

II. THE CONDITION OF THE EARS IN THE DEAF AND DUMB, AS ASCERTAINED BY EXAMINATION DURING LIFE.

The condition of the ears in the deaf and dumb is very various, and in the majority of the ears there is some abnormal appearance, although it is often very slight. Thus, in only 197 out of 411 patients were the ears healthy. The following table shows the condition of those ears that were not healthy :—

In 66 the surface of the membrana tympani was dull.
38 the membrana tympani was opaque.
12 the membrana tympani was more concave than natural.
3 the membrana tympani was very concave and opaque.
1 the membrana tympani was shrivelled.
10 the membrana tympani had fallen inwards.
9 the membrana tympani was perforated.
18 the membrana tympani was absent, from ulceration.
2 the meatus was full of cerumen.
35 the meatus was full of cerumen, and the membrana tympani opaque.
3 the meatus externus formed a *cul-de-sac* half an inch from the orifice.
1 the meatus contained a polypus.
3 the membrana tympani of one ear was opaque, and in the other it had fallen inwards.
2 the membrana tympani was opaque in one ear and absent in the other.
1 the membrana tympani was normal in one ear and absent in the other.
3 the membrana tympani was fallen in in one ear and perforated in the other.
1 the membrana tympani was natural in one ear and the meatus full of cerumen in the other.
1 the membrana tympani was fallen in in one ear and dull in the other.
1 the membrana tympani was absent in one ear and the meatus contained a polypus in the other.
1 the membrana tympani was very concave in one ear and had fallen inwards in the other.

In 1 the membrana tympani was natural in one ear and very concave in the other.
1 the membrana tympani was perforated in one ear and opaque in the other.
1 the membrana tympani was very concave in one ear and absent in the other.

It is interesting to observe the difference between the condition of the ears in the acquired and congenital cases.

The condition of the ears in the 313 *congenital cases* :—

172, or nearly three-fifths, had a natural appearance.

In the 172 *cases of absolute deafness* the following was the condition of the ears :—

96 had a healthy appearance.
In 37 each membrana tympani was dull.
20 there was an accumulation of cerumen, and each membrana tympani was dull.
12 each membrana tympani was opaque.
1 each membrana tympani had been destroyed by ulceration.
2 one membrana tympani was opaque, the other had fallen in.
1 one membrana tympani was opaque, the other was absent.
1 one membrana tympani was natural, the other was opaque.
1 one membrana tympani was natural and the other was absent.
1 one membrana tympani was fallen in and the other was perforated.

172

The following was the condition of the ears in the 141 congenital cases, in which certain sounds were heard :—

(*a.*) In 11 who heard a clapping of the hands, 7 had a normal aspect.
In 2 each membrana tympani was opaque.
1 each meatus was distended by cerumen, and the membrana tympani was opaque.
1 each membrana tympani was concave.

(*b.*) In the 44 who heard a shout :—

21 were apparently natural.
In 7 each membrana tympani was dull.
4 „ „ „ and the meatus full of cerumen.
4 „ „ „ opaque.
4 „ „ „ concave.
2 „ „ „ concave and opaque.
2 „ „ „ perforated.

(*c.*) In the 39 who heard a loud voice :—

24 were apparently normal.
In 7 each membrana tympani was dull.
3 „ „ „ and the meatus full of cerumen.
3 „ „ „ opaque.
1 „ „ „ concave.
1 in one ear the membrana tympani was normal; in the other it was opaque, and the meatus full of cerumen.

(*d.*) In the 43 who heard the vowels and repeated them after me :—

24 appeared to be normal.
In 6 each membrana tympani was dull.
5 „ „ „ and the meatus was full of cerumen.
5 each membrana tympani was opaque.
1 „ „ „ concave and opaque.

(*e.*) In the 5 who heard words and repeated them :—

2 appeared normal.
In 1 each membrana tympani was dull.
1 „ „ „ and the meatus was full of cerumen.
1 in one ear the membrana tympani was opaque and concave, and in the other it had fallen in towards the promontory.

(*f.*) In the single instance in which short sentences were heard and repeated, the membrana tympani was dull.

The condition of the ear in the 98 *acquired cases of deafness.*

Of the entire number only 23, or about one-fourth, had a natural appearance; of the 75 cases of acquired deafness, in which there was no power of hearing, 19, or about one-quarter, were apparently normal; including those instances in which the surface of the membrana tympani was only slightly dull, 27, or about one-third of the whole, had a natural appearance. Of the 25 acquired cases in which there was a certain amount of hearing power, 5, or one-fifth, were apparently healthy.

Scarlet Fever.

In the 36 cases of scarlet fever only two patients had the ears in a healthy state; in 15 each membrana tympani was absent, and in 5 each membrana tympani was perforated; in 3 each meatus formed a *cul-de-sac* about half an inch from the orifice. It is clear, therefore, that in the majority of cases of deafness from scarlet fever, the effects of very active disease were apparent; this disease was usually catarrhal inflammation of the tympanic mucous membrane, ending in an ulceration of that membrane, which extended to the labyrinth. As it is interesting to observe the relation between the amount of hearing possessed by a patient, and the condition of the ears, I have arranged the results in the following forms:—

(*a.*) Condition of the ears in the 27 patients who were entirely deaf:—

In 1 each ear was apparently healthy.
4 the surface of each membrana tympani was dull.
1 each membrana tympani was concave.
2 „ „ „ fallen in.
3 „ „ „ perforated.
13 „ „ „ absent, and there was catarrh of the tympanic mucous membrane.
3 each meatus formed a *cul-de-sac* about half an inch from its orifice.

(*b.*) Condition of the 9 patients by whom certain sounds are heard:—

In the single individual who heard a clapping of the hands, each membrana tympani was absent.

Of the *five* who heard a loud voice :—

In 1 the membrana tympani was fallen in.

2 „ „ „ perforated, and there was a polypus in the meatus.

2 „ „ „ absent in each ear.

Of the *two* who pronounced the vowels :—

In 1 the membrana tympani was dull and opaque.

1 in the right ear the membrana tympani was fallen in ; in the left ear it was absent.

In the *one* child who pronounced short words both ears were apparently natural.

Condition of the ears in the 23 *cases of deafness from fever :—*

(*a.*) In the 17 who did not hear any sound :—

3 were apparently healthy.

In 2 each meatus was distended by cerumen.

3 each membrana tympani was opaque.

1 „ „ „ dull.

1 „ „ „ white and shrivelled.

2 „ „ „ fallen in.

1 „ „ „ perforated.

1 „ „ „ destroyed by ulceration.

1 each meatus full of paper, each membrana tympani fallen in and red.

1 right ear, the membrana tympani concave and thick ; left ear, membrana tympani perforated and fallen in.

1 right ear contained a polypus ; in left ear the membrana tympani was absent.

(*b.*) In the 6 who heard sounds.

In the four who heard a shout :—

1 each membrana tympani was dull and opaque.

1 „ „ „ perforated ; the mucous membrane of the tympanum being thick.

1 each membrana tympani was dull.

1 right ear, the membrana tympani was perforated ; left ear, the membrana tympani fallen in and corrugated.

In the single instance in which a loud voice was heard, each membrana tympani was opaque ; and in the case where the patient tried to articulate words after the speaker, each ear was apparently normal.

Condition of the ear in the four cases of measles :—

(*a.*) Of the three who were deaf :—

In 1 each ear was apparently normal.
1 each membrana tympani white and thick.
1 right ear, the membrana tympani dull; left ear, membrana tympani dull, and fallen in.

(*b.*) In the patient who heard a clap of the hands, each membrana tympani was thick and white.

Condition of the ear in the 35 cases of deafness produced by various diseases, as teething, convulsions, hydrocephalus, a fall, fits, a fright, &c. :—

In seventeen cases each ear appeared to be normal. In several of the others the membrana tympani was dull on the surface, opaque, or concave. In three cases it had fallen in; but in only two was it perforated: thus showing a marked difference between the effects of these diseases and those of scarlet fever; where it will be remembered that, in 20 out of 36 cases, each membrana tympani was either absent or perforated. I will give, first, the condition of the ears in the patients entirely deaf, and then the condition of those having various degrees of hearing.

(*a.*) Condition of the ears in the 26 patients who were entirely deaf:—

14 appeared natural.
In 2 each membrana tympani was dull.
3 „ „ opaque.
4 „ „ concave.
1 „ „ fallen in.
1 one ear appeared natural; in the other the membrana tympani was fallen in.
1 in one ear the membrana tympani was opaque; in the other it was absent.

In the case where the clap of the hands was heard, each ear appeared to be natural.

(*b.*) Of the 3 who heard a shout :—

1 appeared to be natural.
In 1 each membrana tympani was opaque.

In 1 the membrana tympani of one ear was concave, and it was natural in the other.

(*c.*) Of the *four* who heard a loud voice :—

1 appeared natural.

In 1 each membrana tympani was opaque.

2 the membrana tympani of each ear had fallen in.

In the single case where the vowels were heard, the membrana tympani of one ear was opaque, and it was perforated in the other.

III. ON THE CONDITION OF THE EAR IN THE DEAF AND DUMB, AS REVEALED BY DISSECTION.

It is highly desirable that careful dissections should be made of the ears of deaf and dumb patients whose cases have been carefully noted during life, in order that the condition of the organ may be compared with the amount of hearing possessed by the patient. Pathological investigations into the condition of the ear in the deaf and dumb have, however, been too seldom conducted, to enable us to draw any conclusive general deductions as to the condition of the ear in deaf-mutes. I purpose now to give the details of five dissections performed by myself, and to follow them with a tabular view of the morbid appearances found in all the other dissections of similar cases that have been met with by me.

Dissection 1.—A woman, æt. 40, deaf, and consequently dumb, from birth. For the last ten years of her life she was insane, and was confined in a lunatic asylum. The petrous bones were sent to me, immediately after the death of the patient, by the late Mr. Crosse, of Norwich.

Right ear.—The meatus externus, membrana tympani, and the tympanic cavity were in a healthy state. *Labyrinth.*—The anterior limb of the superior semicircular canal communicated with the vestibule, but was rather larger than natural, and its shape somewhat irregular. Examined as it passes inwards, it was observed to terminate in a *cul-de-sac*, after having attained only half its usual length. The portion of bone in the situation usually occupied by the inner part of the canal was of an ivoid whiteness, and could be distinctly distinguished from the surrounding bone. The greater part of the posterior semicircular

canal was absent, its anterior and posterior extremities presenting two *cul-de-sacs*, half a line in length. The external semicircular canal, the vestibule, and cochlea were in a normal state.

Left ear.—The superior semicircular canal is in the same incomplete state as that of the right ear.

Dissection 2.—J. C., æt. 50, died from fever. He was born deaf, and had been educated as a deaf-mute.

Right ear.—Meatus externus in a natural state, excepting that one part of the osseous parietes was quite rough. Membrana tympani thicker than natural, and perforated: a small red polypus was attached to its dermoid layer. A membranous band connected the stapes, incus, and tensor tympani muscle. The osseous semicircular canals were large; but they did not contain any membranous tubes. The cochlea was in a normal state, as were also the tympanic muscles and nerves.

Left ear.—The osseous semicircular canals did not contain any membranous tubes. One of the osseous canals was so contracted as to admit of the passage through it of a fine wire only.

Dissection 3.—R. B., æt. 16, a girl, sharp and intelligent. Her parents stated that she was born deaf; but the child, on the contrary, said that she had heard sounds. Her teacher thought the child's statement the more likely to be correct, as she pronounced many words according to their proper sounds. None of her relatives were deaf-mutes. Upon making a careful dissection of each ear, no deviation from the normal condition could be detected in the meatus externus, membrana tympani, or tympanic cavity. The stapes adhered to the fenestra ovalis with its usual degree of firmness. The membranous labyrinth in the vestibule was healthy, as also was that in the semicircular canals, with this exception, that in the middle of the superior semicircular canal in the right ear was a quantity of otoconie (ear crystals), which completely obstructed the tube.

From the occurrence of an accident to the left ear, it was not possible to ascertain its condition.

Dissection 4.—A boy, æt. 15, who had been wholly deaf from his birth. No deviation from the normal state in either ear could be detected by me.

Dissection 5.—For the opportunity of making this dissection, I am indebted to Dr. Ormerod of Brighton. The ears were

taken from a young woman deaf and dumb, with discharge from each ear. She died with tubercular inflammation of the brain.

Right ear.—The membrana tympani was absent; the mucous membrane of the tympanum red, and of extreme thickness, so as to fill the whole of the tympanic cavity and to conceal the stapes; the tympanum was distended with dark-coloured blood. The petrous bone was so intensely hard, that it could with difficulty be cut by the bone forceps. The cochlea, to the naked eye, had a natural appearance, and submitted to microscopic examination, no deviation from the normal structure could be detected, excepting in that portion of the lamina spiralis which is near to the vestibule. This, instead of being composed of a delicate osseous lamina and a fine membrane, the two making a delicate septum between the scala tympani and scala vestibuli, presented a mass of solid bone filling up the scala tympani, and concealing from view the membrana fenestræ rotundæ; the inner surface of which it wholly covered. The outer surface of this membrane could, however, be distinctly seen from the tympanic cavity, and it appeared natural.

The semicircular canals contained more otoconie than natural.

Left ear.—The membrana tympani absent. The mucous membrane of the tympanum thick and red, as in the right ear. The semicircular canals contained more otoconie than natural, and especially the posterior one, which, at its junction with the posterior limb of the superior canal, was wholly distended with crystals for the extent of half a line. The lamina spiralis of the cochlea was of a deep red colour, and blood was effused in both scalæ. The part of the lamina spiralis near to the vestibule was in the same state as the same portion in the right ear.

In the subjoined table the condition of the ears in deaf-mutes, as revealed by various reported dissections, is shown.

A TABULAR VIEW OF THE CONDITION OF THE EAR IN THIRTY-SIX DISSECTIONS OF DEAF MUTES.

Meatus Externus.	Membrana Tympani.	Tympanum.	Labyrinth.	Nerve.	Name of Observer.
Absent.	..*	..	..	As soft as mucus.	Itard.
Absent.	..	..	..	..	Fabricius.
Absent.	..	..	..	..	Do.
..	..	..	..	..	Itard.
..	Destroyed.	Containing vegetations from the mucous membrane; ossicles absent.	..	..	Do.
..	Do.	Do.	..	..	Do.
..	Partially destroyed.	Containing scrofulous matter.	..	..	Mr. Cock.
..	Do.	..	..	..	Do.
..	Do.	..	..	..	Do.
..	..	Containing calcareous concretions.	..	..	Itard.
..	..	Full of gelatinous matter.	Full of gelatinous matter.	..	Do.
..	..	Containing a yellow fluid.	..	Harder than natural.	Rosenthal.
..	..	Anchylosis of stapes to fenestra ovalis.	..	..	Valsalva.
..	..	All the ossicles wanting.	..	..	Reimarus.
..	..	..	Vestibule full of caseous matter.	..	Dr. Haighton.
..	..	..	Cochlea consisting of only one turn and a half.	..	Mundini.
..	..	..	Vestibule, cochlea, and semicircular canals absent.	..	Meckel.
..	..	..	Semicircular canals wanting.	..	Murer.

* Where no entry is made, it is to be assumed that the part of the organ was in a healthy state.

Meatus Externus.	Membrana Tympani.	Tympanum.	Labyrinth.	Nerve.	Name of Observer.
..	Partially destroyed.	All the ossicles wanting.	Two of the semicircular canals imperfect.	..	Mr. Cock.
..	..	..	Do.	..	Do.
..	..	..	..	Atrophied.	Sylvius.
..	..	..	..	Indurated.	Arneman.
..	..	..	..	Wanting.	Morgagni.
..	..	..	Fenestra rotunda closed by bone in each ear.	..	Mr. Cock.
..	..	..	One semicircular canal incomplete in one ear only; the other ear healthy.	..	Dr. Thurnam.
..	..	..	Aquæductus vestibuli very large.	..	Dalrymple.
..	..	..	..	Very hard.	Rosenthal.
..	..	..	Semicircular canals absent in one ear.	..	Murer.
..	..	..	Filled with caseous matter.	Half its usual size.	Dr. Haighton.
..	..	..	..	Atrophied.	Hoffman.
..	..	..	..	Compressed by a tumour.	Duverney.
..	..	..	A portion of one of the membranous semicircular canals filled with otoconie.	..	Author.
..	..	..	The superior and posterior semicircular canals incomplete in right ear; the superior incomplete in the left ear.	..	Do.
..	..	..	Membranous semicircular canals absent.	..	Do.
..	..	..	..	..	Do.
..	Destroyed.	Mucous membrane thick.	Lamina spiralis near the vestibule filling the scala tympani.	Otoconie obstructing the canals.	Do.

IV. ON THE MODE OF EXAMINING A CHILD SUPPOSED TO BE DEAF AND DUMB.

From the absence of precise experiments from which accurate conclusions could be drawn, great difference of opinion frequently exists, even among medical men, as to whether a child suspected of being deaf and dumb really is so.

It frequently happens, therefore, that a child is reported not to be deaf, because it always starts or looks up when the door of the room is loudly knocked, or the floor over the room is tapped with considerable force, or the fire-irons in the room are permitted to fall, or the piano is played. A similar opinion is often formed because a child can utter some short syllables, as "Mam," "Pa," &c., it being argued that no child could learn to utter these sounds unless it had heard them. It is also asserted, that a child could not have been born deaf, because the defect was not discovered until it had reached the age of a year and a half or two years.

In reply to the above arguments in favour of a child's being able to hear, it must be borne in mind that loud sounds are always accompanied by more or less vibration of the walls and floor of the apartment, which can be *felt* by a person whose attention may thus be attracted, although totally deaf. A child may also learn to utter short words by simply imitating the movements of the lips of the parent, or nurse, without the exercise of the sense of hearing. The plan adopted by me to ascertain whether a young child is deaf, consists, in the first place, of allowing it to sit on the knee of the nurse or parent, and be amused by something, and then while its eyes are fixed upon the object, to speak loudly, or shout, taking especial care that the breath does not reach the patient. Again, let the child, its attention distracted as before, be placed with its back towards the surgeon, who should, when near it, clap his hands loudly, ring a large bell, or blow a powerful whistle, always taking care that his own shadow is not seen, and that the child is screened from the movements of the air, while the nurse is warned not to start or suddenly look up; or the surgeon may come into a room, the door of which has been some time open, and where the child is seated with its back towards him surrounded by toys, and perform similar experiments. If the child does not evince

any symptom of hearing, by suddenly lifting up its eyes, turning round, or starting, it must be concluded that it is wholly deaf; but if, on the contrary, it looks up each time the surgeon shouts, or turns round quickly the instant the hands are clapped, it is evident that some power of hearing exists, and steps should be taken to ascertain the extent of such power, and how far it may enable the child to be orally taught.

V. ON THE MEDICAL TREATMENT OF THE DEAF AND DUMB.

It is of great importance that the surgeon should be able to decide what treatment, if any, should be pursued when deaf and dumb children are brought to him.

The first rule which may be laid down is, that in those cases where there is no hearing power whatever, and in which it is supposed that the nervous apparatus is either incomplete or much disorganized, no treatment for the purpose of improving the hearing should be resorted to. The friends of the child should be told that there is no hope of any change, and that it will have to be educated as a deaf-mute.

On the contrary, should there be a certain decided amount of hearing power, some attempt, it is obvious, should be made to develop it. Where the child is evidently born deaf, general medicinal treatment is not required; and the only remedy is the use of means to excite the nervous system of the ears to natural action. By the persevering use of the long elastic tube, the hearing power has, in some cases, been decidedly increased.

In cases where by disease subsequent to birth, either the membrana tympani, or the mucous membrane lining the tympanum, has been thickened, counter-irritation over the mastoid process will aid the use of trumpets; and in those where the membrana tympani has been partially or wholly destroyed by ulceration, and where there is a constant discharge of mucus from the surface of the tympanic mucous membrane, it is desirable for the ears to be syringed, and occasionally with a weak astringent, so as to prevent the membrane becoming ulcerated, and the bone which it covers, carious. The artificial drum may also be resorted to.

VI. THE AMOUNT OF HEARING POSSESSED BY CHILDREN EDUCATED AS DEAF AND DUMB.

The examination of a large number of children usually considered to be wholly deaf, and consequently educated as deaf-mutes, shows that a large proportion are not *totally* deaf, but that, on the contrary, certain sounds are distinctly heard. Thus, it will be observed, that of the 411 children examined at the Deaf and Dumb Asylum, 245, or three-fifths, were quite deaf, not hearing any sound; while 166, or two-fifths, heard certain sounds. The 166 cases in which certain sounds were perceptible, may be classified as follows:—

14 heard a clapping of the hands.
51 heard a shout close to the ears.
50 heard a loud voice close to the ears.
44 distinguished vowels, and repeated them.
6 repeated short words.
1 repeated short sentences.

166

Of the 411 children it has already been stated that 313 were cases of congenital deafness, while 98 were acquired cases.

Of the 313 *congenital cases*—

172, or about five-ninths, were deaf—*i. e.*, no sounds were heard by them.
141 heard certain sounds.

313 congenital cases.

The 141 cases in which certain sounds were heard may be classified as follows:—

11 heard a clapping of the hands near to the head.
44 heard a shout.
39 heard a loud voice.
41 heard the vowels, and repeated them.
5 heard words, and repeated them.
1 heard short sentences, and repeated them.

Of the 98 *acquired cases*—

73, or about three-fourths, were *deaf.*
25 heard certain sounds.

The 25 acquired cases in which certain sounds were heard may be particularised as follows :—

Arising from *scarlet fever*, 9 :—

1 hears a clapping of the hands.
5 hears a loud voice.
2 pronounce the vowels.
1 pronounces short words.

Fever, 6 :—

4 hear a loud shout.
1 hears the voice.
1 hears the voice, and tries to imitate it.

Measles, 1 :—

1 hears a loud clapping of the hands.

Various Diseases, 9 :—

1 hears a loud clapping of the hands.
3 hear a shout.
4 hear a loud voice.
1 repeats the vowels.

VII. ON THE EDUCATION OF THE DEAF AND DUMB.

The observations to be offered upon the system usually adopted for the education of the deaf and dumb, have reference to two points : *first*, the improvement of the power of hearing ; *second*, the use of the vocal organs.

1. *Of the improvement of the power of hearing.*

It would be very interesting to know how far the facts respecting the hearing power of so-called deaf and dumb children, cited in a previous part of this chapter, are corroborated by the observations of others. Itard hazarded the opinion that one-half of the pupils at the Deaf and Dumb Institution at Paris were wholly deaf, and that the other half heard some sounds. It is assumed by the writer of the very interesting article on the Deaf and Dumb, in the "Penny Cyclopædia,"

that the same proportion of the totally deaf to those who hear a little, will be met with in our English institutions. If there exist throughout the deaf and dumb in England relatively, as many cases of a large amount of hearing as in the London Institution, steps taken to improve the hearing power might be productive of the most valuable results; especially as my own limited experience warrants the assertion that this power is capable of considerable development, as may be seen by the cases appended. Though one of these does not belong to the category of the deaf and dumb, yet the long duration of nearly total deafness in one ear, followed by so great a restoration of its dormant power, renders the case of great interest in the present inquiry. The treatment calculated to improve the hearing, consists in the use of trumpets, whereby the nervous apparatus may be gradually excited, as to become sensitive to ordinary sonorous undulations and external stimulants. While quite agreeing with Mr. Wilde, that we cannot hope to *cure* cases of deaf-mutism, I still think, when there already exists the power to hear the vowels so distinctly as to distinguish and repeat them, that from the exercise of the ear considerable improvement may reasonably be anticipated; sufficient, in fact, to aid in carrying out the end above all things to be desired, viz., *the exercise of the organs of speech.*

The influence of the use of the vocal organs upon the general health has, it seems to me, scarcely been sufficiently considered in the education of the deaf and dumb. Sir H. Holland, with his usual acuteness, has placed the subject in its just light. He says, "Might not more be done in practice towards the prevention of pulmonary diseases, as well as for the improvement of the general health, by expressly exercising the organs of respiration; that is, by practising, according to some method, those actions of the body, through which the chest is alternately in part filled or emptied of air? Though suggestions to this effect occur in some of our best works on Consumption, as well as in the writings of certain continental physicians, they have hitherto had less than their due influence, and the principle as such is little recognised or brought into general application. In truth, common usage takes, for the most part, a directly opposite course, and, under the notion or pretext of quiet, seeks to repress all direct exercise of this important function in those

who are presumed to have a tendency to pulmonary disorders." —*Medical Notes*, c. xx., b. 422.

To this, I may be allowed to add, in reference to the deaf and dumb, that in those cases where the organs of speech are not used, and where, consequently, the lungs, and the muscles of the chest, and heart are not duly exercised by the act of articulation, the general health always suffers.

But the great advantage of calling forth the auditory power of so-called deaf-mutes is, that they may be enabled to hear their own voices, and to modulate them; for the extreme harshness and monotony of the sounds produced by deaf-mutes, arise from the impossibility of regulating the tones of a voice which they cannot distinguish.

CASES.

Miss L. L., æt. 23, consulted me in the early part of the year 1857. Her history was, that since childhood she had heard only certain loud sounds, and was quite deaf to all conversation. Her means of comprehending what was spoken were derived from watching the movements of the lips, and the sounds she uttered appeared to be the result of her attempts at imitating the movements she saw. Upon examination, having found that the voice was heard when spoken into the ears, I recommended counter-irritation and the use of a long elastic tube. At first she could hear only for from three to five minutes at a time. In a fortnight there was decided improvement in the hearing power, and she began to experience a painful sensation in the ears when too loudly spoken to. To use the words of her sister (who devoted herself to the poor patient in a way that only a sister or parent could), "During the third week the improvement was wonderful. This was not so perceptible with the tube as in her hearing generally. Everything was so much louder to her, but *not* more distinct. The noise in the street now quite annoyed her: she called it dreadful, although, when we arrived in town, she did not notice it." She left me at the end of a month's treatment, and I directed her to be spoken to daily, but only in words of one syllable, which she was to repeat to herself. Then very simple sentences were tried; which she

heard and understood when spoken to through the tube in the ordinary way of conversing; and replied by speaking through the tube herself, so that she was able to hear her own voice and modulate it. Her sister writes :—"In October, 1857, she spent three weeks at ———, and there she was seen by people who saw her just before she came to consult you : they said they should not have believed it possible for her to have improved so much in hearing and articulation ; her mind, too, had come out so. During the three weeks she was from home, she had a complete holiday (*i. e.*, the tube was not used), and when she came back, the hearing had not retrograded generally, but she did not hear so well through the tube. Since her return from a visit, she has gone on steadily with the use of the tube. Latterly,"—this was written on February 2nd—"for some weeks, I have talked through the tube daily an hour divided into three or four intervals. Two or three times, when much amused, she bore its use, without fatigue, half an hour at a time, and she said she could have borne it longer. Even when she has had a difficulty in comprehending what was said, I have never allowed her once to see my lips while talking through the tube. We spelt the words which she could not make out, and she never once failed to find them out by the aid of the ear alone. One afternoon she could not understand a single word of sentences she had distinctly heard in the morning. By degrees, however, she made out a word here and there, and in a few minutes heard everything I said. She had been absorbed in writing a letter till a minute or so before the use of the tube. Several times now, I observed that she heard far *more* easily at the end of our talk than at the beginning. To her best ear I am obliged to talk in a high treble, not loud. The left ear requires a deeper, stronger voice. Great distinctness and slowness are necessary—a monotonous tone suits her best. The *final* consonants must be strongly uttered. She says she now hears them, but she never did so before. She notices the difference of touch in persons playing on the piano, and can often understand much that is said without seeing the mouth. A few days since she exclaimed, 'You are talking French.' Lately she has gained many new phrases, trying to apply those she hears in conversation, very often making wonderful mistakes. Not long ago she said, 'That tree is a great assortment

for the birds,' meaning 'resort for.' At another time she said, 'I hope you will not think me liberty,' meaning, 'I hope you will not think I take a liberty.' She began to read half an hour a day; it was hard work, although the book was written for a child. As hearing improved, articulation and intelligence improved, and lately I have often wondered at the change. We increased the reading to an hour, my sister constantly saying, 'I feel as if something were coming to my mind,' and expressing surprise that she could understand what she never could comprehend before. She now quite distinguished between *my* mode of pronouncing and her own, and we never had the tube while reading to her, as I knew its use would have distracted her thoughts from her book. Occasionally, when the word was a very difficult one, she made it out, and then had the tube used to convince her of her correctness. Numbers of people have remarked my sister's improvement. A lady saw her the first time in the beginning of August last, and she saw her no more till November, when she said to me in astonishment, 'I could not understand a word your sister said in August; now I can understand everything she says.' When I began your plans, I had to ask my sister, as a favour to myself, to allow me to talk to her sometimes; she was annoyed, and then did not hear so well. Now, things are very different. She very often proposes the use of the tube, and says she wishes you could know what we had done for her."

Another case, very similar to the above, also occurred to me lately.

A young lady, æt. between twenty and thirty, like the case above cited, had never heard sounds so as to be able to speak or read with any degree of distinctness. I subjected her to a treatment similar to that pursued in the above case, and the result was also satisfactory. In about four months I received the following report in a letter from her sister:—"I do think she (the patient) is improving; a good many of her friends also think so." In another letter the same sister writes:—"I really do think the improvement gradually continues, although slowly, which perhaps is the best and surest." The patient herself writes:—"I cannot tell how much I have improved in hearing, reading, and speaking; but I now read much better, and I know the numbers very well by the tube.

I hear everything continually. The G.'s, during my visit there, and Aunt F., say my improvement is much in speaking; they understand me very well, and I am very glad of it."

The right ear useless for sixty years; at the age of seventy so greatly improved as to hear conversation all over the room, by means of a trumpet.

I was called into the country in great haste in the spring of 1856, to see a nobleman, æt. 70, who was suffering from an attack of intense inflammation of the mucous membrane lining the left tympanic cavity. At the time of my seeing the patient, the inflammation had extended internally as far as the labyrinth, and the power of hearing was destroyed. The only means of communication with my patient was by writing. Having but slight hope of doing anything towards the improvement of the hearing power of the left ear, I turned my attention to the right, the drum of which had, I found, been inflamed and damaged in early life. I proposed, amid opposition at the supposed utter uselessness of the experiment, to try the effect of a loud voice spoken into the right ear. The result was decided, the sound of the voice was distinctly heard, and some words were understood. Feeling that the nervous system of this ear was lying torpid, from the circumstance that ordinary sonorous undulations had not been able to reach it through the diseased condition of the membrana tympani and mucous membrane of the tympanum, and also from the weak state of the nerve itself, I determined to try a plan of treatment having a twofold object—the excitement of the nervous apparatus of the ear by the healthy stimulus of sonorous vibrations, through the use of ear trumpets, and an improvement of the condition of the drum, as also of the mucous membrane of the tympanum, by remedial applications. The former of these objects was attempted at once with a most satisfactory result, for the hearing power gradually increased. In short, by the means in question, the latter of the two being principally gentle counter-irritation, the patient's power of hearing in this ear, which had been so defective during sixty years that its faculty was considered "lost," became, in the course of eighteen months, so improved, that for a long time previous to his death, he could hear a voice speaking near to the

ear, and with the aid of a trumpet on his table could carry on a conversation with persons sitting in different parts of an ordinary sized room. In this case I am confident that no good would have resulted from the treatment, if the nervous apparatus of the ear had not been stimulated at the same time by the influence of sounds; and my experience tells me that hundreds of persons are living with one ear supposed to be perfectly deaf, and in reality useless, but which might be made very serviceable, were the sonorous undulations conveyed to it by artificial means.

CHAPTER XIX.

EAR-TRUMPETS AND THEIR USE.

In some cases of diminished power of hearing, there can be no doubt that ear-trumpets afford great assistance, and are a source of much comfort to the sufferers. On the other hand, if imprudently used, they are apt to increase the deafness and to cause additional distress. They are decidedly injurious, for instance, in the early stages of deafness arising from debility of the nervous apparatus, and the noises are likely to be increased by their use; while in the old standing cases of the same disease they often prove most serviceable: they are also equally advantageous in cases of partial anchylosis of the stapes to the fenestra ovalis.

Ear-trumpets may be considered under three different classes, according to their use, in as many degrees of deafness.

The *first* class consists of instruments to be worn on or in the ears, without the aid of the hand; and by means of which more voices than one, or even general conversation, can be heard.

The most useful of this class of instruments are the small cornets made by Mr. Rein, which are connected by a spring passing over the head, that serves also to hold them in the ears. The cornets can be concealed by the hair or worn under the bonnet. A variety of this class is a small cornet, which can equally be concealed by the hair, and which fits into the ear, where it is retained by a convolution which passes around the ear and dispenses with the spring.

The *second* class consists of instruments held in the hand, by means of which one voice, and sometimes more, spoken near the extremity, can be heard.

To this class belong all the varieties of trumpet of different lengths and shapes, whether made of tin, gutta percha, &c., and

consisting of a narrow portion inserted into the ear, which gradually expands into a wide mouth. These trumpets must be held in the hand, and the expanded portion can be directed to any person or persons whose voices are desired to be heard.

The *third* class embraces a variety of elastic tubes, one end being placed in or on the patient's ear, and the other held in the hand of the speaker, whose mouth being applied *near* or *in* its free extremity, his single voice is heard.

APPENDIX.

LIST OF PUBLISHED PAPERS ON THE STRUCTURE, FUNCTIONS, AND DISEASES OF THE EAR.

On the structure of the membrana tympani in the human ear. *With numerous engravings. Philosophical Transactions,* 1851. Part I.

On the functions of the membrana tympani. *Proceedings of the Royal Society,* 1852.

On the muscles which open the Eustachian tube. *Proceedings of the Royal Society,* 1853.

On the mode in which sonorous undulations are conducted from the membrana tympani to the labyrinth, in the human ear. *Proceedings of the Royal Society,* 1859.

Pathological researches into the diseases of the ear. *Medico-Chirurgical Transactions,* vol. xxiv., 1841.

Pathological researches into the diseases of the ear. Second series. *Medico-Chirurgical Transactions,* vol. xxvi., 1843.

Pathological researches into the diseases of the ear. Third series. *Medico-Chirurgical Transactions,* vol. xxxii., 1849.

Pathological researches into the diseases of the ear. Fourth series. *Medico-Chirurgical Transactions,* vol. xxxiv., 1851.

Pathological researches into the diseases of the ear. Fifth series. *Medico-Chirurgical Transactions,* vol. xxxviii., 1855.

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THE END.

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TABLE OF CONTENTS OF SUPPLEMENT.

PAGE

DIAGNOSIS 426

DISEASES OF THE MEATUS.

Foreign bodies—Masses of epidermis—Boils — Syphilitic ulceration — Constriction—Polypi—Sebaceous (or molluscous) tumours 429

THE EUSTACHIAN TUBE.

Appearance of the membrana tympani—Effect of swallowing—Politzer's method of inflating the tympanum—Eustachian Catheter—Bougies—Quotation from "Beneficence in Disease" 442

DISEASES OF THE MEMBRANA TYMPANI.

Effect of increased mucous secretion in the tympanum (Dr. Jago)—Perforations—The artificial membrane, its mode of operation—Puncture of the membrane—Division of membranous bands 448

DISEASES OF THE TYMPANUM.

Treatment of chronic catarrh without perforation of the membrane—Case from "Beneficence in Disease"—Extension to parts within the skull . . 454

DISEASES OF THE NERVOUS APPARATUS.

Effect of mental excitement—Sudden tinnitus with loss of hearing—Menière's cases—Hereditary syphilis—Tinnitus—Mr. Marshall's ear trumpet . . 459

SUPPLEMENT.

CHAPTER I.

DIAGNOSIS.

On the Method of Examining a Case (p. 6).—Since the publication of Mr. Toynbee's work, some advances have been made in aural diagnosis. Among these may be mentioned, first, the use of the ordinary reflector for illuminating the meatus and membrane; a simplification recommended by Dr. Von Troeltsch, and which has for the most part superseded all other methods. It has the great advantage of leaving the hands free, and since any light can be made use of, no apparatus beyond that already in the surgeon's hands is demanded.

Some additional means may be employed for distinguishing affections of the nervous from those of the conducting apparatus. The first of these turns upon the well known fact that when any sound reaches the nerves of hearing through the cranial bones, it is heard more intensely if the meatus be closed: if, for example, a vibrating tuning-fork be placed on the vertex or forehead, and one meatus be closed by the finger, the sound will be heard much more distinctly on that side, and even when it has been lost it may again be rendered audible for a few moments by the same means. Dr. A Lucae who has recently bestowed much pains on the examination of this fact* ascribed the effect to pressure conveyed through the ossicula to the labyrinth, but that this view is not correct any one may readily convince himself, by placing an elastic tube in the meatus, when the same reinforcement of sound will be heard on compressing the tube. It appears to be due simply to the prevention of the escape of the sonorous waves, which are thus thrown back in greater intensity

* Virchow's Archiv. vol. 25. Archiv. der Ohrenheilkunde, vol. 1. p. 303.

upon the internal parts of the organ ; and it depends upon the fact that the tympanum in the natural state is easily permeable to sound in both directions. If a tuning-fork be placed upon a person's head, or if he continue an uniform *hum* with closed lips, it will be found that the sound is conveyed through a tube to the ear of another much more strongly from the meatus than from any other part of the head. In fact sonorous vibrations from within escape through the ear, just as vibrations from without enter by it.*

But if the typanum and meatus cease to be freely permeable by sounds it is evident that this reflection of vibrations conveyed through the bones will no longer take place on closing the meatus. They will have been already obstructed in their passage outward, and the closure will be without effect. Hence conversely it is evident that in any case of supposed disease of the ear, if closure of the meatus does not intensify sounds conveyed through the bones, or otherwise from within, (as that of a tuning-fork or the patient's own voice), it may be inferred that the passage of sound through the tympanum is hindered : that is, the deafness has its seat in the conducting media. There is a limitation to this inference, which will be referred to presently, but it is prima facie valid ; and its truth is proved in some cases of accumulation of cerumen, in which closure of the meatus has no effect on the sound of a tuning-fork until the mass has been removed, when its effect is immediately restored.

Another result of the same cause is that in many cases of deafness wholly or chiefly on one side, the tuning-fork placed on the centre of the head is heard most in the ear most affected. This apparently strange result is a simple consequence of an obstruction existing in that ear to the passage of sound, and it indicates at once the general nature of the disease.

I said above that there was a limit to the inference that the conducting media of the ear are the seat of disease when closure of the meatus fails to reinforce the sound of the tuning-fork. It arises from this cause : that there are a certain number of cases in which such closure produces the opposite effect. In certain diseases of the ear, closure of the meatus *diminishes* sounds

* See Mack. Zur Theorie des Gehörorgans. Sitzungsberichte der Wiener Academie der Wissenschaften. 1863.

conveyed through the bones. It is my belief that this symptom is demonstrative of a disease of the nervous apparatus.* It seems, at least, impossible to refer it to any condition of the conducting media. Now the natural effect of pressure on the meatus—increase of the sound—and this inverse effect, of diminished sound, are by no means incompatible with each other, inasmuch as they arise in independent ways and are due to an action exerted on different parts of the organ. And it is of course possible that cases might arise in which they might just neutralize each other—the diminished hearing from the pressure transmitted to the labyrinth exactly counterbalancing the increase of the sound by the prevention of its escape—and in these cases closure of the meatus might leave the sound unaffected in intensity although the conducting media were normal. In these cases we must still fall back partly upon the general symptoms and the history; but not entirely, for by means of a modification of the otoscope we may in many cases test for ourselves the degree of facility with which sonorous vibrations traverse the tympanum. The instrument consists of 3 elastic tubes joined in a common centre. One is placed in each ear of the patient, the other in the ear of the surgeon: on placing the tuning-fork then on the patient's head its sound will be heard by the surgeon passing from each ear of the patient. If now one of the tubes be closed by pressing it between the fingers, the remaining sound is that transmitted by the other ear, and it is not difficult by closing each tube alternately to distinguish whether sound is more freely transmitted by one ear than the other: or the amount of transmission from each ear singly may be estimated by means of the tube, comparison being made with the sound of the tuning-fork as heard directly by the surgeon's other ear. It is not possible, of course, to determine slight differences in this way, but the method is not without its value in doubtful instances. The statements made by patients respecting the effect of the experiments above described are no doubt apt to be inaccurate. It is striking indeed to how great an extent even cultivated persons will describe what they expect rather than what they perceive; but a little

* I cannot here enlarge upon this subject, but may say in brief that my belief is that it indicates increased tension within the labyrinth.

care suffices to exclude error on this point, especially since the results are very apt to be opposite to the natural expectation. I never receive without repeated examination a statement which answers to what the patient would think likely, as for example that the tuning-fork is heard best by the best ear, or that closing the meatus diminishes its sound. With this precaution, however, I think it is well to add to the routine described by Mr. Toynbee a brief note:—whether the tuning-fork (on the head) be heard well or ill, whether better in one or other ear, and the effect of gently pressing the tragus backwards over the meatus.

It must not be supposed, however, that the mere hearing of the tuning-fork through the cranial bones can be taken as a test of the nervous power. Morbid conditions of the tympanum have a great influence in this respect; and some persons with acute hearing and not advanced in life can scarcely distinguish the sound of a tuning-fork placed upon the centre of the head. The different capacities also of different persons for appreciating various kinds of sound must never be overlooked.

The use of the Eustachian Catheter and other methods of inflating the tympanum, in respect to diagnosis, will be referred to under the Eustachian tube; but a small instrument introduced by Siegler, and called the *pneumatic speculum*, may be mentioned here. It consists of a small vulcanite box ending in a speculum at one extremity and having a slightly magnifying lens at the opposite, through which the membrana tympani may be seen. Communicating with this box, which is air-tight, is an elastic tube, by means of which suction can be exerted on the membrane. Its design was to aid in determining the presence of bands of adhesion in the tympanic cavity, by indicating any spots at which the outward movement of the membrane might be impeded. In this respect it has great value; the membrane may be distinctly seen through it to move sometimes as a whole, at others unevenly and in parts.

CHAPTER III.

DISEASES OF THE MEATUS.

(*a.*) *Foreign Bodies.* (p. 38).—My own experience agrees with that of the author that any solid body which finds entrance into the meatus is with due patience removable by the syringe, and that instrumental interference, beyond perhaps an attempt slightly to shift its position is to be avoided. It is sometimes advisable, however, to place the patient on his side and syringe from below, or if, as often happens, the body is jammed into the angle formed by the anterior wall of the meatus and the membrana tympani, the stream may be most effective while the patient lies on his back.

(*b.*) *Masses of Epidermis.*—It is worth remembering that the accumulation of epidermic masses in the meatus is often aggravated, if it be not induced, by a habit very common with nurses, especially careful ones, of cleaning out children's ears with the corner of a towel rolled up. I have met with many cases in which hard plugs of mingled wax and epidermis have thus been forced down upon the membrane, giving rise in some to serious irritation. After the removal of the epidermic mass it is not unfrequent to find a tumid and granular surface at the bottom of the meatus, or on the membrane, which secretes pus freely, and requires careful watching.

(*c.*) *Boils.*—These frequently form in various parts of the meatus. They are very painful, may produce for a time great deafness, and unfortunately are very apt to recur. Von Troeltsch refers to the case of a man who, with intermissions lasting from a fortnight to two months, had been subject to them for twelve years.*

Like similar affections in other parts of the body they are often epidemic; they frequently occur in weakened constitutions, and it has seemed to me that the milder preparations of iron sometimes act as a preservative. I have been much struck with the frequency with which I have observed them during the

* Lehrbuch der Ohrenheilkunde. Third edit. p. 81.

treatment of chronic inflammatory affections of the tympanum, especially perforations of the membrane; and it has seemed to me also that they are the more prone to present themselves when the deeper lesion is advancing towards a cure, so that their presence might almost be regarded as a favorable sign. This however needs farther observation. There is a concurrence of testimony that the continued use of astringent lotions to the meatus tends to induce them. And Von Troeltsch* says that in one case of obstinate inflammation of the membrana tympani, with discharge, which he so treated, he found that every time the patient kept the lotion in the ear the whole night by means of cotton wool, a small abscess formed in the meatus, though he could use the same lotion, applying it for a few minutes only, for months together. Hagen† states that a boil in the meatus may extend so as to produce an abscess over the mastoid process, in which case an accurate diagnosis would be necessary to distinguish it from the more serious subperiosteal inflammation. It should be remembered, too, that the latter disease in its earlier stages is often accompanied by a circumscribed red swelling of the posterior wall of the meatus, frequently of a conical form and discharging pus at the centre.

In the treatment of boils of the meatus the choice lies between a free incision, the application of warmth, moisture and sedatives, and the endeavour by nitrate of silver (Wilde) or a concentrated solution of sulphate of zinc (Von Troeltsch) to induce resolution. The milder method seems to me in most cases preferable. The use of the knife does not appear to diminish the tendency to recurrence. Hagen who adopts it universally found every fifth case relapse. Of local preventive means the occasional use of white or red precipitate ointment has perhaps most evidence in its favour; and it seems desirable to avoid removing any accumulations by the syringe for a week or two after the subsidence of the affection.

(*d.*) *Secondary Syphilitic Ulceration* of the meatus is sometimes met with, most frequently in the form of a narrow unhealthy ulcer at the orifice attended with an ichorous discharge and general inflammatory swelling of the passage. The appear-

* Loc. cit. p. 80.

† Die Circumscripte Entzundung des aeussern Gehorganges, p. 14.

ance and history sufficiently mark its character, and in the cases I have seen the iodide of potassium and lotio nigra have sufficed to heal it.

(*e.*) *Constriction of the Meatus.*—Sometimes, especially in women, the meatus is so narrowed as to be entirely or almost entirely closed. This is apparently due to a general enlargement alike of the osseous walls and of the tunics, without the presence of any distinct tumour, and with no history of inflammatory disease. The hearing in these cases is much impaired, and I have known it greatly improved by the use, during the night, of small ivory bougies, about three quarters of an inch long, and of gradually increasing size. The patient can introduce and withdraw them, by means of a small string attached to their extremity. I have tried Laminaria, but with less success, on account of the irritation it is apt to produce.

(*f.*) *Polypi.* (p. 81.)—These have been treated of by Mr. Toynbee among the diseases of the Meatus, and it is perhaps seldom the case that growths of this kind have not more or less connection with the walls of the passage. But as the rule, in my experience, they spring from within the tympanum. I have found them both on the external and internal surface of the membrana tympani. In one case after a small perforation not exceeding half a line in diameter, had been several weeks under my observation a polypoid growth developed itself through the aperture. It was several times removed and returned, without any increase in the size of the orifice. With regard to the large fibroid polypi which fill the whole meatus and protrude externally, the membrane being perforated, they appear to grow from the whole or nearly the whole surface of the tympanic cavity, the entire mucous lining of which seems to partake of the hypertrophy. At least this was the condition I found in the only case I have had the opportunity of dissecting.

The classification dwelt upon by Mr. Toynbee is undoubtedly founded on nature, but the intermediate forms are very numerous, and since there are some methods of treatment applicable to all cases, which seem to me somewhat more reliable, and free from danger, than those mentioned in the volume, it is now perhaps of less importance than it may have been former-

ly to determine to which group any given polypus belongs. Growths of this nature in the ear are extremely prone to recur, even after apparent cure, but the degree of obstinacy with which they resist treatment is very variable. In some rare cases they will come away spontaneously and leave a permanently healthy surface; in others they will disappear before treatment and show no tendency to recur; in others their eradication is attended with the utmost difficulty. I do not think it is possible at present always to account for these differences, but besides other causes, such as the scrofulous constitution, or the continued presence of disease in other parts, it has seemed to me that the accumulation of secretion behind the polypus or its root is one of the most frequent sources of difficulty in their treatment, especially in cases in which the membrana tympani is perforated. The viscid matter poured out by the spongy mucous membrane of the tympanum tends to cling about its various crevices and maintain a perpetual irritation which sets every kind of caustic or healing application at defiance. Accordingly a chief object to be aimed at in the management of polypi is the perfect cleansing of the deep seated parts of the organ. This is not to be effected by syringing merely, however vigorous and long continued. Water does not remove the tenacious matter, nor probably does the stream reach the whole secreting surface. The best method, I believe, is that suggested by Politzer, of causing a stream of air to pass through the Eustachian tube while the meatus is filled with a lotion which tends to coagulate the discharge, and so to loosen it from the recesses in which it accumulates. Of such lotions the best, according to my experience, is the sulphate of zinc (from 1 to 20 grains to an ounce), though various others may be alternated with it.

With very few exceptions I believe it is the best plan to remove polypi, and the means I have found best adapted for the purpose is Wilde's snare, which may be used of a larger size than that described by him and is best armed, not with wire, but with what is known to anglers as *Jack-line*. This is at once more flexible and less brittle; it is not less easy to apply, gives less pain, and is less apt to fail. Thus armed the snare is perfectly effective for all but a few sessile growths to which the

lever-ring-forceps are best adapted. I think it is best always to pass the snare as far as possible towards the root of the growth and then to cut it through, not to pull or tear it out. The divided root may as a rule be dressed not with caustic, but with simply absorbent powders (such as talc or French chalk) in the same way as that hereafter recommended for the treatment of the exposed mucous membrane of the Tympanum. When there is a great tendency to sprout again, caustics may be applied occasionally (nitrate of silver, potassa fusa or chloride of zinc), but only as adjuvants to the treatment by absorbent powders. By themselves caustics, according to my experience, are scarcely to be relied upon to produce a permanent effect. If long continued they are apt to irritate, and increase the mischief; if discontinued speedily, the surgeon may be disappointed after the lapse of a little time by witnessing the return of the growth he thought he had eradicated. The treatment by absorbent powders may be tedious (it is by no means always so), but it is safe and seems to be permanently effective.

In the latter part of his practice Mr. Toynbee attempted to bring about the disappearance of polypi without removing them by applying gentle but continued pressure by means of small pieces of sponge or portions of wool. Instances are known to me in which the apparent effect of this treatment was satisfactory, but the result was not permanent.

I have tried the effect of *astringent* powders such as alum and tannin upon polypi, and upon their roots after removal, and have not found them on the whole by any means equally satisfactory with simple absorbents. They are useful, however, in some cases. Combined with pressure they often act better than caustics in cases of obstinate recurrence of the growth after removal, and sometimes a soft form of polypus may be killed by them and come away after a few applications as a dead mass. The use of such powders also, or that of undiluted liq. plumbi for a few days will often greatly deaden the sensibility of a polypus and render its removal much less painful.

One further remark seems called for on this subject. At p. 324 Mr. Toynbee lays it down generally as a rule that polypi should not be interfered with when disease of the brain is threatened from irritation within or in the neighbourhood of the tympa-

num. I cannot but feel that this is a rule which needs reconsideration, and that perhaps even so accurate and thoughtful an observer has been in this particular unduly biassed by the unfortunate issue of a single case. When cerebral irritation coexists with polypoid growths of any considerable size occupying the meatus, the removal of such growths should rather be a point engaging the surgeon's earliest attention, for they are often themselves a chief source of the irritation of the nervous centre by hindering the escape of matter. After their removal in such cases, indeed, it is no uncommon thing for the syringe to bring away large semi-solid masses of old discharge, the removal of which is followed by a great mitigation of the symptoms. In truth the removal of polypi in these cases is only the carrying out of Mr. Toynbee's own principle of securing a free outlet for the discharge—a principle which should be applied without exception.

(*g.*) *Molluscous Tumours.* (p. 119).—To these growths Mr. Toynbee, subsequently to the publication of this volume, applied the name of sebaceous tumours, and in two papers read before the Medico-Chirurgical Society,* he gave the particulars of 20 more cases, of which number the sebaceous tumour was the immediate cause of death in five. I have myself met with at least 3 cases in which death ensued from the same cause, all of them before middle age, and as the subject is one to which Mr. Toynbee paid great attention in his later years, and as the short notice of it in the volume by no means does justice to his more mature views, I here subjoin a portion of the papers above referred to.

"There can be but little doubt that cases of this disease occuring in the ear, and producing very singular results, must be constantly presenting themselves to the notice of members of the medical profession; it is not improbable that they are included under the catagory of cases of otorrhœa, and when the petrous bone and the brain become diseased they are probably looked upon as cases of caries resulting from otorrhœa.

"The results of my observations upon the *structure* of these sebaceous tumours tend to show that they are almost wholly composed of flattened cells of a large size, and very similar to

* Trans. of Med. Chir. Soc. Vol. 44, p. 51, and Vol. 47, p. 203.

those constituting the epidermis. These cells are arranged in layers; they are enclosed in a distinct membranous envelope, formed of areolar tissue. When developed in the ear these tumours do not appear to result from a morbid change of the hair-bulb or its follicle; indeed they frequently occur in the innermost part of the meatus close to the membrana tympani, where no hairs are to be found. Their shape is usually spherical, and they are met with in every part of the external meatus. They possess the singular property of increasing towards their attached surface equally with that towards the cavity of the meatus, and the result is absorption of the petrous bone. I am not aware that I have dissected a single sebaceous tumour in the external meatus, however small, that had not caused some absorption of the osseous wall. These tumours vary in size from a millet seed to a large hazel-nut. When of the latter size, they cause an enormous dilatation of the meatus, so that not unfrequently a finger may be passed inwards as far as the membrana tympani. They also produce absorption of the bone to so great an extent that a communication is found with the mastoid cells, tympanum, cerebral or cerebellar cavities. Their progress would seem to be more impeded by the presence of membrane than by bone, as the membrana tympani frequently remains entire when the surrounding bone has been absorbed. In one case which will be cited, the tumour went through the external and then the internal osseous walls of the mastoid cells, and came into contact with the dura mater; instead of penetrating it, the tumour passed upwards, causing absorption of the posterior, and then of the upper, wall of the petrous bone, and eventually entered the tympanic cavity, without producing any perforation in the dura mater. It is a remarkable feature in this disease that the tumour may pass through the substance of the petrous bone, causing a large aperture in it, without producing any visible effect upon the surrounding osseous tisssue, the margins of the aperture being often as sharp and well defined as if made by a chisel.

Sebaceous tumours grow in the external meatus and even reach to a considerable size, causing absorption of the bone, without the occurrence of pain; indeed as a rule, the attention of the surgeon is called to them either on account of the deaf-

ness which follows the occlusion of the meatus, from the presence of a fetid discharge, or from symptoms of irritation of the brain, which too often terminates in death.

"The only disease for which sebaceous tumours are likely to be mistaken is the presence of one or more osseous growths in the meatus, covered by the dermis; gentle pressure with the rounded extremity of a probe is, however, sufficient at once to discriminate between the two kinds of growth.

"*Treatment.*—Considering how strong a tendency sebaceous tumours have to advance inwards, and thus to injure the membrana tympani and the bone, the effort of the surgeon should be to extirpate them as completely as is practicable. A simple incision into the substance of the tumour, and the evacuation of its laminated contents, is productive of no permanent benefit, the layers of epidermoid cells being rapidly reproduced. The desired object is the removal of the firm capsule of the tumour, which appears to be the parent of the cells. This can be effected by making a crucial incision into the tumour, and after squeezing out the laminæ the firm wall may be seized by a pair of forceps and the whole of it withdrawn. In the latter stages of the disease, when ulceration has taken place in the free surface of the tumour, producing discharge of a highly fetid odour, much care is required in the removal of the laminated contents of the tumour, and more especially of the wall, the attached surface of which may be in contact with the dura mater. In the first place, the ear should be frequently syringed with warm water, the stream being directed against the contents of the tumour. The flakes that remain, after this operation has ceased to bring away any further secretion, may be carefully seized and withdrawn by the lever-ring forceps, with which instrument the outer wall of the tumour may also be extracted. In cases where, from the remote position of the tumour, it is found impossible to extract the wall, it is of importance that the case be carefully watched, and the laminæ removed as fast as they are secreted. It might appear unnecessary to remove the contents of the tumour so completley when a large opening exists towards the cavity of the meatus, but from the observation of cases it is highly probable that being open towards the cavity of the meatus, and even freely dis-

charging, does not prevent a sebaceous tumour advancing towards the brain."

The following are among the additional cases cited by Mr. Toynbee:

"*Case* 1.—*A sebaceous tumour developed in the posterior and outer part of the external meatus, causing extensive absorption of the petrous bone, and accompanied by an abscess in the cerebellum.*—M. W. Æt. 24, was admitted under my care as an in-patient of St. Mary's Hospital on the 6th of July, 1860. Of a delicate constitution, she had always resided with her parents, attending to the minor household duties and teaching in a Sunday School. Since a child she is stated to have been subject to sick headaches. Four or five years ago she began to have a discharge from the right ear, and seven weeks since this ear was attacked by violent pain, which was followed by a sudden increase in the quantity of the discharge. Accompanying the pain in the ear there has been a very severe pain in the head, which has wholly incapacitated her from following any kind of occupation. When seen on the 7th of July, she suffered from constant pain at the back of the head and neck, accompanied by giddiness; at times the pain extended to the forehead, and she became delirious. She had double vision, but she saw distinctly with either eye when used singly. Pulse 80 and weak. The meatus was full of thick flaky discharge of a very fetid character. Leeches were applied behind each ear, and a blister to the nape of the neck. On the following day there was intense pain in the head, both in the frontal and occipital regions. The patient lay on her back, moaning constantly and sighing deeply. Pupils equal, and perhaps slightly dilated; they were perfectly sensitive to light. Pulse very slow, varying from 20 to 16 per minute. The patient died suddenly at 2.30 a.m. on the 10th, immediately after taking a cup of tea for which she had asked.

"*Autopsy.*—On removing the brain, no abnormal change was observed until the tentorium on the right side was punctured, when two or three drachms of serous fluid escaped, the quantity escaping last being turbid. The cerebellum on the right side was found to be adherent to the corresponding petrous bone for a space of about one third of an inch in diameter; at this

part, as well as at the superior surface of the bone, the dura mater was discoloured. On examining the cerebellum, an abscess of the size of a large walnut was observed at the anterior and superior part of its right hemisphere; it was quite superficial, and its walls were thin. The meatus externus was full of discharge, principally composed of flakes looking like masses of epidermoid scales. On the removal of this discharge an aperture was observed in the outer part of the osseous meatus at its posterior surface. This aperture, the margins of which were sharp and well defined, measured about three quarters of an inch long and half an inch broad. It was surrounded by perfectly healthy bone, and communicated with a cavity which was full of laminæ, having the appearance of epidermis arranged concentrically, and bearing an exact resemblance to the tumours I had frequently examined to which the name molluscous or sebaceous had been applied. This sebaceous matter extended backwards through an aperture in the posterior part of the petrous bone as large as that in the meatus, and was in contact with the dura mater, which separated the walls of the abscess from the tumour. The laminated sebaceous matter also extended upwards at the posterior part of the petrous bone, having completely destroyed the superficial layer of bone, and then passed horizontally outwards, beneath the bone forming the upper part of the petrous bone, until it reached the tympanic cavity, which it entered and wholly filled, pressing upon the inner surface of the membrana tympani and causing an orifice in it.

"*Case* 2.—*Sebaceous tumour distending the tympanic cavity; caries of the petrous bone; death.*—N. F. A girl, æt. 16, was admitted into the hospital on Dec. 21st 1862; she had been ill two days with pain in her neck; she was unable to walk, and she kept her head thrown back. She went through an attack of scarlet fever seven months previously, but perfectly recovered, and was in service till within a few days of her admission. There was no history of deafness or discharge from either ear, nor was any discharge observed when the nurse washed her. Next day she seemed much better, and lay with her head naturally on the pillow. On the third day after admission she complained much of headache, started up in bed several times

during the morning but ate her dinner at one. Half an hour afterwards she suddenly died.

"*Autopsy.*—The tentorium on the left side adjacent to the petrous bone was inflamed, and pus was effused upon it. The pia mater covering that part of the cerebellum beneath the inflamed tentorium was opaque, and a portion of the cerebellum itself, as large as a pea, was softened and of a green colour.

"*Dissection of the temporal bone.*—The dura mater covering the posterior and upper part of the petrous bone was dark-colored and softer than natural, and the bone which it covered contained numerous small apertures. These apertures were so numerous and large in the sulcus lateralis, which forms the posterior boundary to the mastoid cells, that it assumed a carious aspect. The lateral sinus adhered less firmly than natural to the sulcus lateralis, and it contained a dark clot.

"*External meatus.*—At the upper and inner part, directly above the membrana tympani, was a soft yellowish mass of matter, composed principally of laminæ of epidermis; its removal disclosed a circular aperture in the upper osseous wall of the meatus, about a quarter of an inch in diameter, its margins being well defined and the bone around having a healthy structure. This aperture was also filled with a mass of epidermoid laminæ, and it communicated with the cavity of the tympanum.

"The membrana tympani presented two apertures, one anteriorly and inferiorly, the other posteriorly and inferiorly.

"*Case* 3.—*A sebaceous tumour in the external meatus, causing caries of the petrous bone, suppuration of the pia mater and death.*—A boy æt. 16, thin and not healthy looking, who was training for an army bandsman, was sent into hospital on February 7th 1864, complaining of pain in and about his right ear; this he attributed to having worn a damp cap a few days previously; there was no discharge from the ear, nor indeed any abnormal external appearance. A dose of calomel was administered followed by a purgative, and the pain continuing, twelve leeches were applied to the region of the mastoid process; a blister was also applied to the nape of the neck; in spite of this treatment, he rapidly became delirious. A week after admission an abscess was opened behind and below the mastoid

process, and a large quantity of very offensive pus was discharged. The severity of the cerebral symptoms increased nevertheless, and the patient died on the eighth day after admission.

"*Autopsy*, three hours after death.—The brain was generally very vascular, and serum was effused in the ventricles. The outer surface of the middle lobe of the cerebrum was intensely congested, and the larger vessels contained coagula; the entire surface of the right hemisphere of the cerebellum was coated with fetid, green, purulent lymph, and the discoloration extended nearly half an inch into its substance.

"No abscess was detected either in the cerebrum or in the cerebellum, the structure of the brain, with the exception just named, being apparently healthy. The dura mater was detached from the upper surface of the petrous bone, and the bone presented carious orifices. The dura mater over the posterior and outer surface of the petrous bone, and that forming the lateral sinus, was also separated from the bone by offensive pus, and there was also purulent lymph in the lateral sinus itself, together with a considerable coagulum. There was a considerable quantity of serum in the pericardium, purulent serum and lymph in both pleural cavities, and purulent deposits in both lungs.

"*Dissection of the temporal bone.*—At the upper and inner part of the external meatus, close to the membrana tympani, was a mass of soft sebaceous matter, which extended by means of an aperture nearly half an inch in diameter (formed partly in the upper part of the membrana tympani, and partly in the adjacent bony meatus), into the tympanic cavity, which it completely distended. There were small carious orifices in the upper wall of the tympanum, and also in the sulcus lateralis, which contained dark and fetid purulent matter.

"The two following cases indicate the mode in which the disease may be advantageously treated:

"*Case* 4.—*Sebaceous tumour in the right ear, accompanied by pain and deafness; removal; cure.*—Mr. F. æt. 45, consulted me in the year 1854 on account of pain in the right ear and side of the head, attended by copious fetid discharge and deafness. He stated that during several months he had experienced an uncomfortable sensation of fulness in the ear, which had

terminated in deafness; and that within the last two months the pain had greatly increased, and the discharge had appeared and had become constant without affording any relief to the pain. Upon examination, the meatus was observed to be distended by a large greyish mass, from which a milky fluid oozed. By the aid of the syringe and warm water a considerable quantity of this discharge was removed, together with large white flakes. The interior of the tumour, which could now be examined, was seen to consist of white layers; some of these were withdrawn by the aid of the lever-ring forceps.

"Two days afterwards the cavity was again full of discharge and white flakes; these were removed in the same way as before. By thus using the syringe and lever-ring forceps, the mass of the tumour was removed, and ultimately the firm wall of the tumour was withdrawn. The latter operation was followed by a diminution of pain, the discharge slowly subsided, and in a fortnight the patient wholly recovered, and I believe that he has had no return of the disease.

"*Case* 5.—*A sebaceous tumour in the right ear attended by great pain and discharge; cure.*—C. W. a gentleman æt. 54, consulted me in the month of July 1860, on account of a violent pain in the right ear and side of the head, accompanied by discharge. The origin of the affection was stated to be a cold, supervening upon an attack of scarlet fever at four years of age. From that period until eighteen years of age, during the spring easterly winds, he had attacks of ear-ache sometimes in one, at others in both ears; each attack commonly terminated in discharge. Between eighteen and twenty-four there was an intermission of the attacks, but at the latter age deafness began to be manifest. At twenty-seven another attack of pain occurred in the right ear; the suffering was intense, and lasted several hours and terminated in the exfoliation of a small piece of bone. These attacks recurred at various times and were always accompanied by copious discharge of glutinous matter, and very often of a tough whitish substance something like gristle. In the intervals of these severe attacks a soreness was experienced in the ear accompanied by throbbing and by noises like the rushing of water, hissing and singing. The late Mr. Pilcher

attended the patient in some of the severe attacks and removed considerable portions of a white substance from the ear.

"At the time of my seeing the patient, the right outer meatus was closed by the presence of a large white tumour, the interior of which was exposed and poured out an offensive discharge. By the aid of the syringe and warm water some flaky matter was removed, which did not however in the least degree diminish the pain in the ear and side of the head; these symptoms, however, completely subsided on the removal of a large mass of yellowish-white material which, upon examination, proved to be a sebaceous tumour."

CHAPTER XI.

THE EUSTACHIAN TUBE. (p. 188.)

In reference to the diagnosis of obstructions of the Eustachian Tube Mr. Toynbee's remarks need a slight modification in two particulars.

(1.) The increased concavity of the membrana tympani, stated by him to be characteristic of such obstruction, is not always present except in children. In young patients when the tube has been impervious for any length of time, this indrawn and dulled appearance of the membrane is seldom if ever absent; often it exists in a most marked degree, the membrane falling back from the malleus on each side like a tightly drawn curtain; but in adults it may present a great variety of appearances; it may appear almost normal, or even, as I have remarked in some cases in which passing air into the tympanum produced an immediate improvement of the hearing, may have a partially convex aspect.

(2.) The act of swallowing, whether the nostrils be closed or not, does not increase the pressure of air in the tympanum, but diminishes it; and it is therefore the suction of air out of the tympanum, not the forcing of air into it, which is heard through the otoscope during that act. This has been proved by Politzer by means of the introduction of a small manometer, air-tight, into the meatus, when the coloured fluid is seen to fall during swallowing; and in some not very rare cases in which there exist thinned spots in the membrane, either as scars of former perforations, or as the results of superficial ulceration, this effect of swallowing may be plainly seen; the thinner portions visibly falling inwards during swallowing especially when the nose is closed, and bulging when the ear is inflated.

With regard to the treatment of Eustachian obstruction, especially in children, in whom it seems to be more frequent than in adults, an immense advance has lately been made by Politzer who has suggested a new and very simple method of introducing air into the tympanum in such cases.* Starting from Mr. Toynbee's discovery that the tube is opened by the palate muscles during the act of swallowing, Politzer selected the moment of swallowing to introduce a blast of air into the upper part of the pharynx. This he accomplished by means of an elastic bag provided with a flexible tube. The tube he introduced into the patient's nostril, and bidding him swallow, forcibly compressed the bag at the same moment. The patient swallows readily if he previously takes a little water into the mouth, and the nose being closed over the tube, the compressed air exerts a strong pressure upon the mouths of the Eustachian tubes at the same moment that their muscles tend to render them patent. Most obstructions yield at once to this proceeding, which may also be several times repeated if necessary. If the tympanum be free from excess of secretion and the membrane unruptured, the air often enters with a loud clap, a sound which, I imagine, arises from the sudden relaxing of the tense membrana tympani. Indeed it most resembles the *crack* produced by quickly bending an elastic piece of cardboard, and I have found it a certain sign of a great improvement of hearing, the concave membrane also at once resuming, more or less completely, its natural position.

If on the other hand the Eustachian tube or tympanum contain mucus or other secretion in excess, the sound is one of a squeaking or gurgling character. Various other sounds also may be produced, which, as in the use of the Eustachian catheter, convey to a practised ear much information as to the condition of the parts within. By the same means, too, in cases in which the patient is unable to inflate the tympanum, assurance may be gained as to the existence or non-existence of a perforation of the membrane, when, as is often the case, the eye cannot decide this point.

In carrying out this method of opening the Eustachian tube the surgeon may simply blow through a piece of elastic tubing, or may employ an elastic bag provided with a valve, by means of which a succession of quick currents of air can be kept up while the patient drinks by small mouthfuls. The latter plan is very effective where the obstruction is considerable. And if the form of bag used for the eye-douche be employed, it affords a simple and portable method of introducing medicated vapours into the tympanum if it be desired so to do.

Of course it is not every case of Eustachian obstruction which can be thus even temporarily overcome; nor is the effect, except in a certain number of cases, permanent. But it appears to me that recourse to this method is desirable in every case of impervious Eustachian tube that does not speedily yield to ordinary measures, and that for two reasons: first, that the abnormal condition of the tympanic cavity induced by the obstruction is thus for the time put an end to, and a confirmed deviation from the natural state, in the form of a relaxation from stretching of the membrana tympani, an altered position of the ossicula, or the formation of adhesions, rendered less probable; and secondly, that a permanent cure is facilitated, the escape of mucus from the tympanum is rendered more easy, and the tumefaction of the faucial mucous membrane more readily subsides. To this it may be added that the pressure on the membrane and ossicles, which closure of the Eustachian tube induces, can hardly be ignored as a cause of irritation to the brain. The use of this method of inflating the tympanum greatly diminishes the number of cases in which the

Eustachian catheter might otherwise be used, but my experience has led me to attach to the latter instrument great value both in diagnosis and in treatment. It happens sometimes, for instance, that even in cases in which nervous symptoms seem well marked, in which the membrana tympani looks healthy, and air forced into the tympanum by the patient enters with a natural sound, the introduction of air by the catheter is attended with wheezing and creaking sounds indicative of irregularity and narrowing of the Eustachian tube, and showing thus that a morbid condition of the mucous membrane has been present. In other cases the loud harsh rushing sound with which air enters the tympanum indicates at once a dry and unyielding condition of parts that should be supple. I cannot indeed affirm that any direct indications for treatment are derivable from the data thus obtainable by the catheter, or that great disappointment would not result from methods of cure based simply upon them. But this does not deprive them of their value, at least as elements contributing to the future perfection of our knowledge, and as aids in unravelling the complicated connections of tympanic disease with that of the labyrinth or deeper portions of the auditory apparatus.

The following remarks on the treatment of closure of the Eustachean tube are from Mr. Toynbee's address on "Beneficence in Disease:"

"Supposing a case of this disease to be before us, and recognizing the fact that the deafness is caused by a closure of the Eustachian tube from thickened mucous membrane, and consequent absence of air from the tympanum, the first suggestion, of course, is to open the tube and to blow air into the tympanum. And this procedure, followed as it is by instantaneous relief to the deafness (and by Politzer's operation without discomfort) is likely to be very popular. But supposing the deafness relieved by the injection of air into the tympanum, inasmuch as this air soon disappears, and the thick mucous membrane prevents the natural ingress of the air, of course the deafness soon recurs. A second suggestion then offers itself; it is to reduce the thickened mucous membrane by topical applications, and thus allow the tube to be opened by

its muscles. To this end gargles are used, nitrate of silver or other astringents applied to the fauces, and possibly the condition of the mucous membrane is so far improved, that the muscles of the tube again perform their functions, and the tube being opened the deafness again disappears. But the remedies being discontinued, the membrane again thickens, the tube again closes, the deafness again appears. Then arises a *third* suggestion, to ascertain the signification of this thickened mucous membrane, to make out what nature may be endeavouring to effect by thickening it. And if the patient be a child, perchance it may be that nature, through this thickened membrane, is endeavouring to rid herself of the scrofula taint, or if the patient be a middle aged man, it may be that nature through this thickened membrane, is endeavouring to rid herself of the gout poison.

"And if we address ourselves to the assistance of Nature, and aid her first by keeping out of the system any further influx of the scrofulous or the gouty poison, and secondly by removing from the system the scrofulous or gouty poison already there, we shall, so to speak, ward off the necessity of Nature thickening the membrane; this will then return to its natural state, the Eustachian tube will be opened by its muscles, and the deafness disappear, in this case permanently. Of course it is often desirable to carry out the first and second suggestions as well as the third, but these suggestions are to be followed in the inverse order of their enumeration here; that is to say, the constitutional remedies for the removal of the injury are first to be enforced, then the mucous membrane of the fauces may be treated by local application; and lastly, if, as is not uncommon, the muscles of the Eustachian tube, from want of use, are unable to open the tube, it may be opened by operation."

To the means recommended by Mr. Toynbee for removing thickening of the faucial mucous membrane may now be added the use of pulverized fluids, which can easily be directed into the region of the Eustachian tubes, and of Weber's nose-douche; Dr. Von Troeltsch also has suggested the use of a straight silver tube with small perforations at the extremity, through which fluids can be distributed over the upper region of the pharynx.

But in the old chronic cases, in which all such means must be ineffective, the introduction of vapours, or weak astringent solutions through the Eustachian catheter may re-open the tube. In cases of still greater obstinacy, thin catgut or elastic bougies may be safely if carefully introduced and will very seldom fail to to effect a passage; but it should be remembered that the opening of an obstructed tube does not necessarily benefit the hearing.

My preference is for very pliable elastic bougies varying from half a line to a line in diameter by which no dangerous force can be exerted, but which will by degrees insinuate themselves through apparently very dense obstructions. Patience is necessary in their use, and that tactile skill which practice gives; they should not occasion any considerable pain. Bougies of a larger size may be used for the wider portion of the tube. They may remain in the canal from one to fifteen minutes. Laminaria bougies are very effective and rapid in their action, but are painful and apt to cause irritation, and it seems to me that cases demanding their employment are exceedingly rare. It is chiefly by these that a rupture of the lining membrane of the tube would be likely to be caused; an accident which is followed by the passage of air into the cellular tissue of the neck. I have witnessed this result twice, but it was attended with the slightest posssible inconvenience and passed off in a day or two. Dr. Guye, of Amsterdam, has reported two cases* in which he found it advisable to puncture the uvula and the soft palate on account of difficulty of breathing arising from this cause. Moderate caution would in all probability ensure a perfect freedom from danger of this kind; but it is only just to state that Mr. Toynbee's opinion was adverse to the employment of bougies, which he had at one time used extensively, but had abandoned.

Another case of complete closure of the faucial orifice of the Eustachian tube, besides that related by Mr. Toynbee, apparently due to ulceration after small-pox, has been reported by Lindenbaum.†

Dr. Jago's description of the symptoms of patency of the Eustachian tube, as experienced in himself, and published in the British and Foreign Medico-Chirurgical Review for January,

* Archiv. der Ohrenheilkunde, vol. 2. p. 16.

† Ibid. vol. i. p. 295: In this case the tensor tympani was atrophied.

1867, p. 175, deserves a careful study. This condition, I think, must be rare. I have met with one instance only in which similar symptoms were at all well-marked; though, as Dr. Jago also remarks, it is not unfrequent to hear complaints of noises on breathing, or buzzing of the voice in the ears, which suggest the occasional occurrence of this condition. As a means of exploration of the Eustachian tube, Rhinoscopy may be had recourse to, though I believe it is practically available in few cases. Dr. Loewenberg,* who has carried his experiments in this direction very far, states that by means of it there may be discovered:

(1.) Crusts of inspissated mucus covering the Eustachian tubes even when none are present in the visible parts of the throat. In such crusts he found once complete casts of the faucial extremities of the tubes.

(2.) A granular condition of these parts, and in one case yellowish red granulations.

(3.) Swellings of considerable size, projecting into the pharynx from the posterior nares, and making the introduction of the catheter without Rhinoscopy impossible.

(4.) In syphilitic and scrofulous patients suffering from deafness, Rhinoscopy has aided Loewenberg in determining whether or not the general disease was concerned in the local malady.

CHAPTER VIII.

MEMBRANA TYMPANI, (p. 123.)

An important suggestion in regard to the membrana tympani has been made by Dr. Jago,† based upon observations and experiences of his own. Dr. Jago was led by certain symptoms to believe that the condition of the *surface* of the membrane, as to

* The value of Rhinoscopy and the Throat and Nose Douche in the Diagnosis and Treatment of Diseases of the Ear and Nasal Portion of the Pharynx. Archiv. fur Ohrenheilkunde, Vol. 2.

† On the Functions of the Tympanum. Brit. and For. Med-Chir. Rev., April, 1867, p. 496.

dryness or moisture, had a great influence upon its power of receiving and propagating sounds, and found, on experimenting, that a thin layer of water covering the membrane involved a considerable degree of deafness; in which point the experience of all who have had much occasion to syringe the ear must agree with his: a lodgment of water at the bottom of the meatus often producing a decided deafness relieved at once by the escape of the fluid. From this fact Dr. Jago infers that the layer of mucus naturally present on the inner surface of the membrane has a similar effect in hindering the transmission of vibrations from the membrane to the air of the tympanum, and thus serves the physiological purpose of concentrating them upon the ossicles—the only channel, in his view, through which they pass. At the same time, this moisture on the internal surface of the membrane prevents it from receiving sounds arising within the tympanum, or entering it through the Eustachian tube, and thus helps to keep us in unconsciousness of them. But in irritation of the membrane, from cold or injury, this layer of mucus is, in Dr. Jago's opinion, increased in quantity beyond what the cilia can remove, and becoming dry forms a sound-absorbing layer on its inner surface, which thus becomes assimilated in its acoustic properties to the external. Two consequences result: in the first place, sounds which arise within the tympanum—especially sounds produced by over-fullness or constrictions of the vessels of the tympanum—are transmitted by the membrane to the ossicles; and becoming audible give rise to tinnitus; and secondly, deafness also ensues, to a certain extent, in consequence of the sounds from without being too freely transmitted by the membrane to the air within the tympanum, and thus dissipated and lost. Hence one of the commonest forms of deafness, usually transient, but doubtless often laying a foundation for permanent injury to hearing. When it passes away it ends suddenly with a *crack* or *rip*, the tinnitus ceasing, and the hearing at once returning. This is due, Dr. Jago thinks, to the sudden falling off of the layer of dried mucus, leaving the inner surface of the membrane again covered by its natural moisture, and again therefore fitted to receive and retain sounds from without, and refuse those from within. Whatever be the value of these views (and they are deserving

of the greatest respect), they pass at one point at least beyond the region of theory. That certain cases of deafness, unattended with closure of the Eustachian tube, terminate suddenly with a a crack or report in the ear, Dr Jago states as a fact proved by his personal experience, inasmuch as in his case the tube was freely pervious through the whole attack. In this respect the current opinion, which ascribes such reports always to a sudden opening of the tube, requires to be modified, though probably not wholly to be put aside.* My own experience has led me to suspect that a great part is played in the production of tympanic deafness by the presence of dried and inspissated mucus, and Dr. Jago's view therefore appears to me to possess, so far, a high degree of probability, which is strengthened by the fact that the appearance of the membrane is frequently such as to suggest the presence of a layer of dried mucus adherent to its inner surface. This appearance has two chief forms (1) that of more or less diffused patches of hazy whiteness, as of an opaque layer seen through the transparent external laminæ of the membrane, and (2) that of a white thickening of its circumference at certain parts, especially of the superior border, forming more or less angular lines, and evidently altogether different from the slightly opaque margin so frequently seen, and which recalls so strongly the arcus senilis of the cornea.

In the treatment of *perforations of the membrana tympani* a great improvement has been introduced in Politzer's method of cleansing the tympanum (referred to under the treatment of Polypi), which consists in causing the patient to force air through the Eustachian tube if he is able to do so, or in passing it for him till he becomes able, while the meatus is filled with a solution of sulphate of zinc or other cleansing or astringent lotion. By thus freely mixing air and lotion within the tympanum, with the subsequent use of the syringe, the cavity becomes in time thoroughly cleared of its contents of viscid or purulent secretion, and even old perforations, if not of very great

* Dr. Jago's paper contains much suggestive matter concerning the physiology of the Membrana Tympani and Tympanum, for which the reader is referred to the original.

size, under this treatment will often heal. It is desirable sometimes to touch the edges of the orifice with nitrate of silver, or sulphate of zinc in powder; and the treatment should be intermitted at intervals of a few weeks especially if contraction is taking place, to give the edges of the wound opportunity to adhere. When the orifice is very large, exposing the greater part of the inner wall of the tympanum, which under these circumstances is generally red and spongy, and secretes a large quantity of offensive discharge, the same method of cleansing should be perseveringly carried out, and after syringing, the ear should be thoroughly dried, which I have found best done by inserting the soft *fringe* of a towel. When dry, the whole of the exposed surface should be covered with a thickish layer of an absorbent powder, and this process should be if possible repeated daily, from the time when the tympanum appears thoroughly cleared of old secretion until it entirely ceases to secrete—a period occupying in an ordinary case 2 or 3 weeks. If progress is not made the dressing with the powder may be discontinued for a time, and resumed after a farther cleansing. By these means this tedious and otherwise very intractable affection may with something like certainty be brought to an end in a moderate time, and according to my present experience without tendency to relapse. The powder to which I give the decided preference is *Talc*, and I believe a chief part of its superiority consists in its being almost entirely free from astringent properties. It acts I believe simply by keeping the mucous membrane dry. I frequently unite with it hydrochlorate of morphia, one grain in 30. It is easily applied by being blown over the surface through an elastic or other tube.

The artificial Membrana Tympani.—Further experience has entirely confirmed the high estimate placed by Mr. Toynbee on the artificial membrana tympani, nor does it appear that time has any tendency to diminish its efficacy. Cases have been reported of irritation set up by the attempt to wear them, and it is probable that there are instances to which on this ground they are inapplicable; but I think these cases must be rare, though caution and patience are undoubtedly required. In his later practice Mr. Toynbee always preceded the use of the

membrane by a short course of blistering paper behind the ear. Mr. Toynbee also modified the view he at first entertained of the mode in which the artificial membrane produces its effect. This he was partly led to do by intercourse with Dr. Julius Erhard who, without any perforation, found his hearing much improved by the use of cotton wool, and published his experience in a paper entitled "Deafness curable by Pressure."*

Connecting this case with others in which he found the artificial membrane useful without perforation, and interpreting them by the light of his pathological observations, Mr. Toynbee thus summed up the conditions of the ear for which the artificial membrane had been found efficient :—

"Disconnection of the incus and stapes, the membrana tympani being entire, but the tensor tympani ligament, or the mucous membrane of the tympanum, being relaxed."

"2. Partial or complete absence of the long process of the incus, the membrana tympani being entire."

"3. Disconnection of the stapes and incus, the membrana tympani being perforated, and the tensor ligament or the mucous membrane of the tympanum being relaxed."

"4. Partial or complete loss of the long process of the incus, the membrana tympani being perforated and the ligaments of the stapes being relaxed.†

The most characteristic symptom of disconnection of the incus and stapes, is an inability to hear except during the act of listening. In the other cases, whether there be perforation or not, there is generally the history of a catarrhal affection, and the relaxed condition of the membrane is evident upon inspection. Sometimes inflation of the tympanum deteriorates the hearing, which may be improved by sharply drawing in the breath, or pressing on the tragus. Mr. Toynbee also introduced a new form of artificial membrane consisting of a bubble of India-rubber containing air, which he found in some cases more successful than the disc.

Puncture of the Membrana Tympani.—Besides cases of impas-

* Taubheit heilbar durch Druck. Berlin.

† Medico-Chir. Trans. Vol. xlix. (1866,) p. 147. Many years ago Mr. Yearsley published the view that the cotton wool produced its effect by supporting the ossicula.

sable stricture of the Eustachian Tube the operation of puncturing the Membrana Tympani has been again proposed in recent times as a remedy for various morbid conditions. Among these are general thickening of the membrane, local earthy or other deposits, and adhesion of its inner surface to the tympanic walls. Excision of a portion of the membrane has been reported as successfully performed for the first of these affections by Dr. Bonnafont* of Paris, and Dr. Philipeaux† of Lyons, and for the others by Dr. Gruber‡ of Vienna. The proceeding however has proved less successful in the hands of Dr. Schwartze§ of Halle, who has tried it extensively, nor does my own experience as yet warrant any considerable expectation of benefit from it in cases of this sort. I have found a small opening productive of considerable temporary benefit in cases in which the membrane appeared to be not so much merely thickened as softened, so that it cut almost like soft sodden leather; but no means seem to be known as yet by which such openings can be made permanent. Earthy deposits are not causes of deafness by themselves, neither, so far as I can judge, is simple thickening of the membrane. When adhesions exist within the tympanum they may be divided more or less completely by means of a small knife, curved near the point on its flat surface, which may be introduced through any desired part of the membrane, and by means of which also gentle traction may be exerted on the handle of the malleus. During his latter years Mr. Toynbee adopted this practice, with apparent success in one or two instances. In one case which I observed, the improvement lasted upwards of a year. It is necessary however to exercise great caution; but doubtless in this as in other respects the surgery of the ear is as yet in its infancy.

In acute suppuration within the tympanum however, whether connected or not with specific fevers, an early puncture of the membrane can hardly be too strongly urged. It gives immediate relief from severe pain, tends to preserve the hearing, and diminishes risk to life. In a certain form also of chronic

* Maladies de l'Oreille, Paris, 1860.
† Archiv. der Ohrenheilkunde, Band ii. p. 58.
‡ Ibid. p. 62. § Ibid. p. 261.

accumulation of mucous or other secretion within the tympanum, puncturing the membrane has been found very useful;* in those cases, namely, in which the secretion is sufficiently abundant, and sufficiently detached from the walls of the cavity, to give rise to a local discoloration or bulging of the membrane when air is forciby passed into the tympanum, either by the patient's own inflation, by Politzer's method, or by the catheter. These cases are most frequent in children; the incision is almost painless, a few drops of mucus escape, and healing takes place generally in from 2 to 4 days. It may be necessary to repeat the incision more than once, but syringing out the tympanum with a warm solution of sulphate of zinc (gr. 2—4 ad. ℥j) appears to diminish the tendency to secretion. For mucus within the tympanum in less amount, as indicated by the moist sounds audible on inflation of the ear, but not forming visible accumulations, incision of the membrane has not been found useful; in Schwartze's hands it has sometimes set up considerable irritation. I have found, however, in a few cases of this kind that a modification of the small syringe used for withdrawing pus from the anterior chamber of the eye, has rendered service. A considerable quantity of tenacious mucus may by this means be withdrawn from the tympanum; but farther experience is needed to determine its permanent value. In the treatment of diseases of the mucous membrane of the tympanum by means of medicated vapours I have tried puncturing the membrane to facilitate their entry, but hitherto without advantage.

Schwartze strongly recommends early incision in the treatment of inflammation of the dermoid layer of the membrane.

CHAPTER X.

DISEASES OF THE TYMPANUM.

The diagnosis of diseases of the Tympanum has been before referred to. In reference to their treatment I subjoin the translation of a passage from Politzer's work on the Membrana Tym-

* Schwartze, loco cit.

pani,* in which the treatment of chronic catarrh of the tympanum and Eustachian Tube without perforation of the membrane, recognized as the most successful by the aural surgeons of Germany is summed up:—

"After inspection of the meatus and membrane and testing the hearing, we proceed to the examination of the Eustachian tube, passing in air either during swallowing or by the catheter, and listening to the sound by means of the otoscope. If a considerable improvement of the hearing follows, giving proof of swelling of the mucous membrane of the tympanum and tube, with excess of secretion, injections of solution of sulphate of zinc into the tympanum are indicated. From 4 to 8 grains may be used to the ounce of water. The catheter is introduced into the tube fixed by the left hand, and after some of the solution has been poured into it by a glass tube, it is driven into the tympanum by means of an elastic bag held in the right hand. This injection should be repeated as the rule every third day, and continued 3 to 5 weeks. If, as in the greater number of cases, there follows not a perfect cure, but only a more or less decided improvement, the injections may be repeated during 2 or 3 weeks, after the lapse of some months, to avert if possible the further development of the disease.

"If on the other hand no improvement or very little follows the frequent employment of the air-douche (i. e. the inflation of the tympanum with air), showing that the deafness must be ascribed to the products of the catarrhal affection—thickening of the membrane and of the covering of the ossicula, with rigidity and diminished mobility of those parts, an improvement can only be expected from the use, besides the air-douche, of moderately stimulating injections. The best are Hydrochlorate of Ammonia ℈j or Iodide of Potassium gr. x, or Chlorate of Soda gr. v, to the ounce of water. After the employment of these injections from 2 to 4 weeks in the way before described, a very decided improvement of hearing ensues in some cases, in others the improvement is very slight, while in another class the tinnitus becomes less, and the confusion of the head, which is a symptom of the process of

* Die Beleuchtungsbilder des Trommelfells. Wien. 1865. p. 91.

chronic thickening of the mucous membrane of the tympanum, is relieved.

"The improvement thus effected, however, seldom lasts for a year, inasmuch as the thickened mucous membrane thus relaxed has, like scar-tissue, a tendency to retract, whereby the rigidity of the ossicula returns. It is necessary therefore from time to time, every 3 or 4 or 6 months to repeat the air-douche, and injections every second day for 2 or 4 weeks. It is especially important to remember that a too protracted employment of these means is injurious; a treatment interrupted by pauses of weeks or months is the most effective."

It will be seen that this treatment is somewhat tedious, but to its frequent efficacy I can bear witness. It is as the rule scarcely painful, either at the time of application or subsequently, and the unpleasantness of the procedure greatly diminishes with repetition. For my own part I prefer a solution of the Hydrochlorate of Ammonia (gr. v—x ad ℥j) to any other, both in cases of mucous accumulation and in the dry thickening of the mucous membrane. I have also found frequent benefit from passing into the tympanum, by means of an air-press, warm vapour of water with Tincture of Iodine, mixed sometimes with Acetic Ether, or from alternating the vapour and the liquid. It is true the benefit is apt to be temporary only, but this is not always the case. In not a few instances I believe the effect of the liquid applications is due to their solvent action on masses of dried mucus, or other secretions in the tympanum. A simple glass syringe fitting into the catheter suffices for the fluid injections and an elastic bag furnished with a tube (also made to fit the catheter), and filled by an aperture which may be closed by the thumb, answers, in the absence of an air-press, for the vapour.

The difficulty of diagnosing *bony* anchylosis of the stapes, and distinguishing it from merely membranous rigidity, however, keeps this department of aural surgery in an unsatisfactory state, and serves to bring into an ill-repute, by no means altogether deserved, its other branches: an ill-repute aggravated by the obscurity which still invests the affections of the nervous apparatus.* Bands of adhesion in the tympanum, as before re-

* There are probably other irremediable causes of rigidity of the chain of ossicles

marked, may be divided by a small curved knife sometimes, or sometimes, it seems beyond question, ruptured by powerful and repeated injection of air into the tympanum on Politzer's plan, with great advantage to the hearing.

The following extract from Mr. Toynbee's "Beneficence in Disease" shows how successful an entirely different mode of treatment may be in cases less confirmed.

"A lady consulted me on account of frequent attacks of deafness, supervening upon colds. I found the mucous membrane of the tympanum thicker than natural, and during each cold a temporary increase of the thickening caused a decided difficulty of hearing. What was the cause of the colds? After some inquiry it became evident that these colds usually followed the change of the warm boots worn in the day to the thin shoes of the evening. The experiment of wearing boots in the evening resulted in the temporary cessation of the attacks of cold and of the deafness. But how was it that this lady could not bear the partial exposure of the feet in an evening? I reasoned thus on the case: can it be that these attacks of cold with their attendant congestion of the mucous membrane and copious discharge of mucus, are for the purpose of repairing some injury to the system—possibly of removing some poison from it? And can it be, therefore, that in this condition of the system the cold applied to the feet brings about a process tending to repair this general injury—in a word, a disease—by inducing a local congestion of the mucous membrane, which, however slight, renders it liable to succumb to the general morbid influence? Without stopping to enquire into the source of the general injury, I suggested tepid sponging every night, followed by active friction; with the view of affording relief to the system by this means, instead of the discharge from the nose. The result was satisfactory; after a week, the shoes were worn with the effect of producing a feeling of fulness ("stuffiness") in the nose without deafness. Then the question came, what was the injury which the cold remedied? The exact nature of the injury I cannot state; but its cause was discovered, viz. sleeping in a

besides bony anchyloses of their joints. I have found, for example, in more than one dissection, small fibroid tumours attached to the tendon of the Tensor Tympani.

heated and close bedroom. When this cause was removed, the colds did not occur on the exposure of the feet in shoes, even when the baths were for a time discontinued. Local remedies soon reduced the thickening of the mucous membrane of the ears, and the deafness was entirely removed."

DISEASES OF THE EAR EXTENDING TO THE PARTS WITHIN THE SKULL.

This subject is so amply discussed by Mr. Toynbee, that it seems almost needless to make any further remark. Yet I feel compelled to express in the strongest terms my feeling that the danger should be more habitually borne in mind and more promptly met than it often is; and especially that whenever there is any threatening of inflammation extending in the direction of the mastoid process, a free incision through the periosteum, as first proposed by Sir W. Wilde, should not be delayed. The ether-spray, rendering the incision painless, removes the only objection to its performance, and every case that I have seen, in which it has been either performed or abstained from, has confirmed my conviction that the latter course is never a wise one. In weakly children, especially, caries of the bone in the mastoid region takes place with remarkable rapidity, and in adults I have sometimes found it diseased when the symptoms have been comparatively slight.

An important sign of disease affecting or tending to affect the mastoid process is, I believe, a circumscribed red swelling of the meatus, on its posterior wall, sometimes but not always discharging matter, and which might almost be confounded with a boil, if other symptoms did not indicate a more serious affection. Where such a swelling exists operative interference should never be delayed.

CHAPTER XV.

DISEASES OF THE NERVOUS APPARATUS.

The advances which have been made in the diagnosis of these affections have been referred to in the first section of this supplement. Recent experience has not added much to our knowledge either of their pathology or treatment. I have, however, been much struck by the frequency with which the symptoms of a passive nerve lesion—a condition suggesting the idea of a functional paresis—coincides with demonstrable tympanic disorder, past or present. There are, however, exceptions to this rule, and not very unfrequently we meet with a gradually increasing inability to hear in persons, especially of the female sex, in whom no trace of physical disorder or mental strain can be discovered. For these latter cases I know no remedies that can be relied on; but where traces even of past tympanic disease coexist with the signs of nerve-debility I have often, though not always, found benefit from treatment directed to the former. It is in these cases, however, that relapses seem most prone to follow.

It is remarkable how small a mental shock suffices in certain persons to give as it were the finishing blow to the power of hearing. One patient whose hearing was previously weak found herself almost totally deaf after a quarrel between two relations who both appealed to her; another, on visiting a sister dangerously ill, was told on entering the house that she was dead. She heard the information perfectly, but on reaching an upstairs room was deaf. In both these cases the affection has continued more or less; but both of them also, when seen by me some years afterwards, showed slight signs of former tympanic disease.

For those cases which I suppose to involve an increased labyrinthine pressure (diminution of sounds heard through the bones of the head on closing the meatus), I know no effective treatment, though patients have professed themselves better under more than one remedy. Another form of nerve-deafness is not very rare and has characters exceedingly well marked: it com-

mences suddenly with noises in the head, accompanied with giddiness and nausea or vomiting—"bilious attacks," the patient often says. The tinnitus persists and is generally very distressing, the deafness is variable in amount but usually severe. This kind of attack is sometimes, but not always, preceded by headache or neuralgia; it occurs in the anæmic and weak, but also in some who are apparently healthy. I have examined the urine in several cases but never found it albuminous.

The idea which the symptoms suggest is that of an apoplexy in some part of the labyrinth, but I have not yet had an opportunity of testing it by dissection. It is probable, however, that these cases are essentially the same as those described by Menière,* in which, with an attack of similar general and aural symptoms, there coexist or succeed difficulty of movement, and unsteadiness of gait. Menière ascribed the symptoms to disease of the semicircular canals, basing this view partly on Flourens' well known experiments, and partly on the following case. A young woman, during the catamenial period, took a long journey on a winter night in the imperial of a diligence. She caught a severe cold, became suddenly completely deaf, suffered from constant giddiness, was sick on every movement, and died on the fifth day. The brain and spinal cord were healthy, and the ears also exhibited no disease with the exception of the semi-circular canals, which were filled with a reddish plastic lymph, a sort of hæmorrhagic exudation. There was none in the cochlea, and very little in the vestibule.

Politzer† noticed similar symptoms follow a fall on the back of the head: after seven weeks acute purulent meningitis ensued, of which the patient died, and it was found that there had been a fracture of both petrous bones and that the meningitis had been caused by the escape of decomposing extravasation from the left vestibule into the internal auditory meatus.

It is highly probable therefore that the semicircular canals are the seat of the affection above described. Its symptoms are strikingly analogous to those produced by pressure on the laby-

* Gazette Med. de Paris, 1861, pp. 29, &c.
† Archiv. der Ohrenheilkunde. Vol. 2. p. 88.

rinth, as by foreign substances pressed into the external meatus.* I have never met with these symptoms coexisting with an affection of the vision.† Nor have I yet been able to trace any definite connection between affections of the labyrinth and of the retina, though my friend and colleague Mr. Bader has made many ophthalmoscopic examinations for me. Myopia is a frequent concomitant of nerve deafness, but by no means a constaut one; in two or three cases slight congestion of the retina has been present; but severe affections of the sight and hearing appear seldom to co-exist except in one class of patients: those, namely, who are the victims of

Hereditary Syphilis. Among the poorer classes of the community, the number of persons whose hearing has been destroyed by this disease is unhappily numerous. At Guy's Hospital it has furnished more than one twentieth of the aural patients. Evidently it is the disease, or one of the diseases, which Sir Wm. Wilde‡ described as affecting the ears in early life, subsequently to, or alternating with, an inflammatory affection of the eyes. The patients present the now familiar aspect of hereditary syphilis and have, in every case I have met with, suffered from impaired vision before the deafness has arisen. This makes its appearance generally between the 10th and 16th year; about, but not precisely coinciding with, the period of puberty. The great majority of cases that I have seen have been in females. In one case the deafness was at first greatly aggravated at the catamenial periods, but it became afterwards almost complete.

Besides their other symptoms—but too well-marked, especially among the poor,—patients suffering from this disease may as a rule, at least when they are young, be at once distinguished by the amount of deafness which they exhibit. I know no other affection, except fever, which in a person under 20 brings on a deafness so rapid and so nearly complete. In the course of

* On the last point see a paper by Mr. Toynbee in the first volume of St. George's Hospital Reports.

† I am well aware that many cases of aural disease of special interest in a pathological point of view, because connected, or at least coincident, with other disease, do not, for that very reason, come under the observation of the aural surgeon unless specially sought for.

‡ Aural Surgery, p. 273. Otitis in connection with Ophthalmia.

a few weeks a girl, previously hearing well, will, without pain or or known cause, become unable to distinguish words. Perhaps her eyes, which have been long inflamed, have about the same time got better. On examination, it is found that a tuning-fork placed on the head is heard for a very short time, or not at all, the meatus is free from wax, the membrana tympani looks somewhat white and rough; it may be flat or too concave, but it generally has a dried up look, as if its juices were deficient. The throat is by no means always unhealthy; the Eustachian tube may or may not be pervious. In the latter case the opening of the tube by the catheter or other means affords some relief, which however is apt not to be permanent. Of the pathology of this disease I can say little, having had as yet the opportunity of dissecting the petrous bones in one case only and that one in which deafness was not a marked symptom. I found a congested state of the tympanic mucous membrane on the right side, and some old adhesions at the upper part of each tympanum; the membranæ tympani very concave, the Eustachian tubes containing mucus. Each vestibule was much congested. From the symptoms, however, it is evident that as in the case of the eye, both the conducting and the nervous apparatus are liable to be involved in this disease. The peculiarly harsh sound produced by passing air into the tympanum suggests the presence there of rough rigid lymph, and the almost total deafness proves that the labyrinth has suffered. Of treatment I can say little definite. In one well-marked and severe case a striking improvement took place under the use of scruple doses of Hydrochlorate of Ammonia, and on the whole has continued for more than twelve months. Perchloride of Mercury and Iodide of Potassium I have not found useful. In the wealthier ranks the symptoms are often much less marked, and in some of these I have found the injection of Iodine vapour into the tympanum produce a good effect.

Tinnitus.—Scarcely any advance has been made, since the publication of this volume, in the empirical treatment of this symtom, but there seems to be a gradual progress towards a better understanding of its significance. When of a beating character, and synchronous with the pulse, it is obviously referable to

vascular conditions as its exciting cause, and among others sometimes to aneurism of the basilar artery. In some cases pressure over the course of the carotids immediately beneath the ear temporarily arrests it. In any such case regard of course should be had to the condition of the heart. Dr. Daldy informs me that he has known various forms of tinnitus, especially when connected with headache or vertigo, to be dependent on a weakened right side of the heart. Dr. Jago* ascribes the tinnitus occuring in subacute catarrhal affections of the membrana tympani to partial compressions of the small arteries by contracting mucus. Perhaps, however, the most frequent cause of tinnitus is pressure on the labyrinth; as illustrated by the the sound heard on pressing on the membrana tympani by a probe. This pressure may arise either from wax &c. in the meatus, or from closure of the Eustachian tube, or from contraction following inflammatory affections of the tympanic cavity, or from an abnormal action of the tympanic muscles: which last I cannot but believe to be a frequent factor in such cases. But in estimating the causes of tinnitus it appears to me that the great frequency with which enlargement and fullness of the blood vessels of the labyrinth are found, on dissection, to accompany even slight inflammatory affections of the tympanum should not be overlooked, and that it may be held probable that any cosiderable amount of tinnitus seldom exists without somewhat of morbidly increased irritability of the auditory nerve. At least, in some cases, conditions which must be supposed to cause great pressure on the stapes, such as an extreme concavity and tension of the membrana tympani, are found without tinnitus; an exemption hardly sufficiently accounted for by the faculty whereby organs "adapt themselves" to variations of condition,† while the same organ is often thrown by a similar amount of pressure into a persistent state of irritation. It would seem better therefore that the causes of tinnitus should be held as yet a very open question. When any disease of the meatus or tympanum co-exists with tinnitus, of course the treatment would be directed to such disease. For

* Loc. cit.

† See Politzer: Subjective Gehorsempfindungen. Wiener med. Zeitung, 1865. No. 67.

tinnitus not referable to such causes, or not amenable to such treatment, excision of a portion of the membrana tympani has been practised with a certain success, but it is a doubtful remedy. Almost the only medicine which I have found even appear to be efficacious is the Hydrochlorate of Ammonia, 20 grains three times a day. This medicine in full doses has seemed to me to have, in certain cases of what may perhaps be called *acoustic neuralgia*, an action similar to that which it has been found to have in some cases of neuralgic pain. I have sometimes known glycerine and laudanum (ʒvij—ʒj), applied warm to the meatus, give great relief. Sedative liniments I have not found effective. There is some evidence also in favour of the occasional usefulness of the continuous galvanic current.*

Some guidance as to the nature and cause of tinnitus may be gained by means of the pneumatic speculum before described (see p. 428). By gentle traction on the membrane noises in the ear are in a large proportion of cases removed, or greatly diminished, for a short time. In these instances pressure on the labyrinth may be probably inferred.

It remains to add, in respect to ear trumpets, that Mr. Marshall, of University College, has recently introduced a new form in which the principle of the Parabola is employed, and the waves of sound are conducted more directly to the ear. It seems to be especially free from reverberations of sound.

* See especially Brenner, Virchow's Archiv. B. 28, and Petersburg Med. Zeitschrift, 1863.

INDEX.

Anchylosis of stapes, 276
Artificial membrana tympani, 160
Auricle
cysts of, 21
eczema of, 20
erysipelas of, 19
malformations of, 13
malignant disease of, 24
tumours of, 23
use of, 11

Bands of adhesion in tympanum, 272, 428, 453
Boils in meatus, 429
Bougies for Eustachian tube, 447
Brain, diseases of ear extending to, 61, 73, 240, 246, 302, 375, 458
treatment of, 76
tabular view of, 345

Calcareous degeneration of membrana tympani, 152
Case, mode of examining a 3, 425
Catarrh of tympanum, 245, 448, 454
Catheter Eustachian, 201
Cerumenous glands diseases of, 44
Cold nerve-deafness from, 349
Concussion ,, ,, 356

Deaf and Dumb the, 395
Debility general deafness from, 367
Dissection of petrous bone, 6

Ear trumpets, 417, 464
Eustachian catheter, 201, 444
Eustachian Tube, 188, 442
anatomy of, 188
appearance of membrana tympani in obstruction of, 6, 195
closure of by adhesive bands 224
comparative anatomy of, 192
exploration of, 195
mode of opening, 190, 443
mucus in, 222
patent, 447
pathology of, 193

Eustachian Tube, (*Continued*).
relaxed mucous membrane of, 211
thickened ,, ,, 194, 445
at tympanic orifice, 215
stricture of, 222, 447
use of, 189
Examination method of, 3, 425

Forceps lever-ring, 88

Illumination modes of, 31

Jago Dr. on the Eustachian tube, 447
,, on catarrh of tympanum, 447
Jugular vein affected in disease of ear, 265, 312

Labyrinth acute disease of, 465
,, ulceration of, 376
Ligament, tensor of membrana tympani, 133

Malformations of ear, 13
Malignant disease of ear, 386
Mastoid cells,
anatomy of, 300
diseases of in childhood, 302
,, the adult, 310
necrosis of, 337
Meatus externus
anatomy of, 27
boils in, 429
cerumen in, 45
constriction of, 431
dermis of, diseases, 56, 429
effect of closure of, 426
exploration of, 30, 35
,, in child, 35
foreign bodies in, 37, 429
inflammation of, acute, 56
,, extending to the brain, 61
,, chronic, 65
,, catarrhal, 69

Meatus externus (*Continued*).
inflammation catarrhal, extending to the brain, 73
insects in, 39
osseous tumours of, 107
polypi of, 81, 431
sebaceous tumours of, 119, 434
tobacco in, 43
ulceration of, 79
,, syphilitic, 430
Membrana Tympani
anatomy of, 123
artificial, 160, 451
calcareous degeneration of, 152
dermis of diseases, 138
diseases of, 137
dissections of, 185
epidermis of diseased, 137
fibrous laminæ, diseases of, 147
functions of, 135, 175,
inflammation of acute, 138
,, chronic, 141
,, catarrhal, 142
perforation of, 159, 450
puncture of, 216, 452
relaxation of, 155
rupture of, 175
tensor ligament of, 133
ulceration of, 145, 148
Mental excitement deafness from, 363
Morbid poisons, deafness from, 359
Mucus in tympanum, 448, 454

Nervous Apparatus of Ear
diseases of, 348, 459
Nervous deafness from concussion 349
,, cold, 356
,, morbid poisons, 359
,, mental excitement, 363
,, general debility, 367
,, diagnosis of, 425

Osseous Tumours of Meatus, 107
Ossicles
articulations of, 295
dislocations of, 298-452
functions of, 175, 288
,, experiments illustrating, 291
Otoscope, 195

Pathology of Ear, 2
Politzer's method of inflating the tympanum, 443
Polypi, 81, 324, 431
Portio dura, paralysis of, 239, 339

Scrofulous Disease of Ear, 303
Sebaceous tumours, 119, 434
Speculum, 32
,, pneumatic, 428
Stapedius muscle, 177
Stapes
anchylosis of, 277
articulation of, 175
disconnection of from incus, 288, 298, 452
function of, 178
movements of, 177
Sulcus lateralis disease of, 312
Supernumerary ears, 19
Syphilis hereditary, 461
Syringing, 51

Tensor ligament of Membrana Tympani, 133
Tensor tympani muscle, 177, 180
Tinnitus, 462
Tonsils enlarged, 197
excision of, 204
Tumours molluscous or sebaceous, 119, 434
,, osseous of meatus, 107
Tuning fork use of, 425
Tympanum
anatomy of, 224
congestion of, 231
dissections of, 228
inflammation of, acute, 232
,, extending to the brain, 240
,, chronic, 243
,, ,, catarrhal, 245
,, extending to brain, 246
injections into, 455
membranous bands in, 272, 428, 453
mucus in, 448, 454
rigidity of, 266
ulceration of, 261

Watch use of, 3

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